THE
BRITISH JOURNAL OF SURGERY

VOL. XLIII MAY, 1956 No. 182

A COMPARATIVE STUDY OF THE EFFECTS OF DIFFERENT ARTERIAL CLAMPS ON THE VESSEL WALL

BY G. F. HENSON
JUNIOR LECTURER, SURGICAL UNIT, ST. MARY'S HOSPITAL, LONDON
AND C. G. ROB
PROFESSOR OF SURGERY, ST. MARY'S HOSPITAL, LONDON

RECENT progress in vascular surgery has resulted in the more frequent use of blood-vessel clamps. In this paper we report the results of a comparative study on the effects of various arterial clamps on the vessel wall and our conclusions as to which are the best methods for occluding a blood-vessel whilst it is being reconstructed.

METHOD

The study has been carried out on patients. During the course of our routine operation of partial gastrectomy, we divide the right gastro-epiploic artery close to its point of origin from the gastro-duodenal artery; for the purposes of this study the operation was modified in the following way: after exploration of the abdomen, a short length of the right gastro-epiploic artery was mobilized and the particular clamp applied. In each instance the clamp was left in position for fifteen minutes, during which time the operation proceeded in the usual way; the clamp was then released to allow a flow of blood through the lumen of the vessel for two minutes and the segment of vessel which had been clamped was then resected. It was examined with the naked eye for signs of injury and then longitudinal sections were cut, stained with hæmatoxylin and eosin, examined microscopically, and photomicrographed.

RESULTS

Altogether, nine different methods of arterial occlusion were investigated. In addition, controls were obtained by examining a segment crushed by an ordinary artery forceps (*Fig.* 661), representing maximal injury, and another segment which had been resected without the application of any clamp (*Fig.* 662), representing no injury. Between these extremes the various methods fell into favourable and unfavourable categories, some of the latter approximating quite closely to the degree of trauma produced by the artery forceps, as shown by the accompanying illustrations.

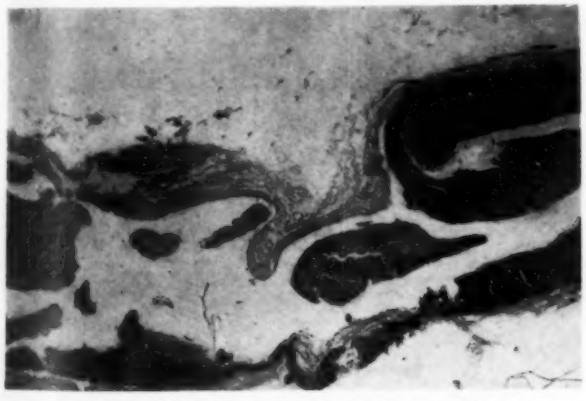


FIG. 661.—Control artery, crushed with artery forceps and showing gross damage.

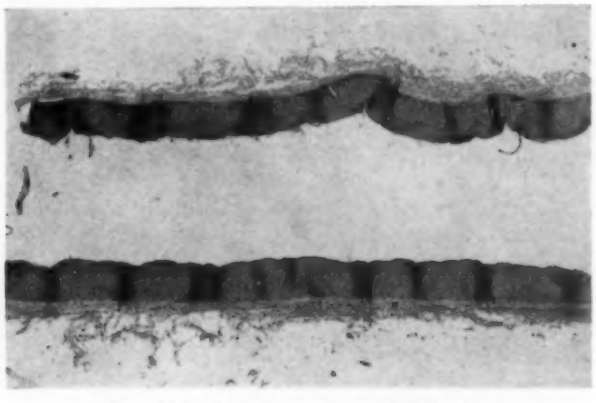


FIG. 662.—Control artery, no clamp used.

At the site of application of the Blalock clamp (*Fig.* 663) the media have been split and dissection of the vessel wall has taken place on each side, resulting in occlusion of the lumen by the stripped media and a weakening of the remaining wall with dilatation of the vessel at this point. The Craaford clamp (*Fig.* 664) has resulted in stripping of the whole

thickness of the media from the overlying adventitia, the lumen in this case being occluded by blood-clot and infolded media.

The Brock auricular clamp, although not designed as an arterial clamp, is often used for this purpose.

FIG. 663.—Artery occluded by the Blalock clamp showing extensive medial dissection.

FIG. 665.—Artery occluded by the Brock auricular clamp showing a transverse tear of the media with dilatation of the vessel wall at the site of occlusion.

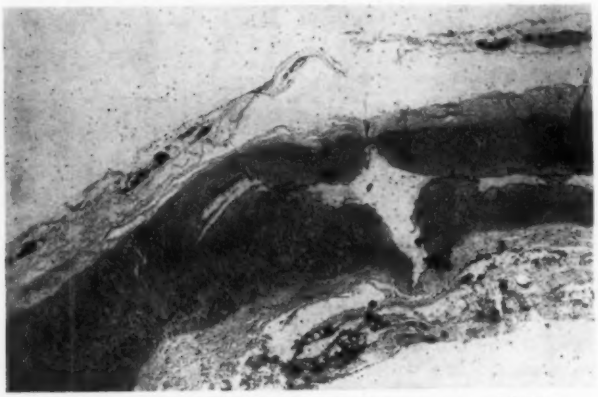


FIG. 667.—Artery occluded by the Potts clamp exhibiting transverse linear damage.

The result following its application (*Fig.* 665) was similar to that obtained with the two previous clamps. Although the severity of the trauma was somewhat less, once again medial stripping has occurred, through its whole thickness in one wall and partially on the opposite wall, with incomplete occlusion of the lumen and a degree of dilatation.

A simple method of occlusion is temporary ligation with silk over a short length of rubber tubing. *Fig.* 666 illustrates the medial splitting and early

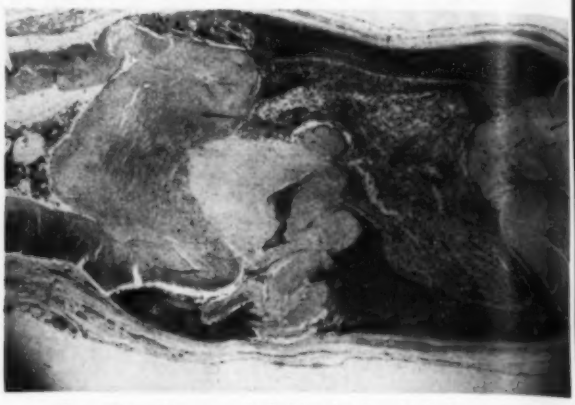


FIG. 664.—Artery occluded by the Craaford clamp showing extensive dissection completely occluding the lumen, which is filled with blood-clot.

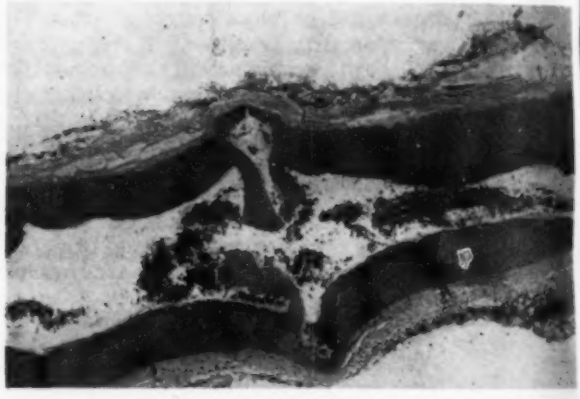


FIG. 666.—Artery occluded by silk ligation over rubber tubing, showing splitting of the media.

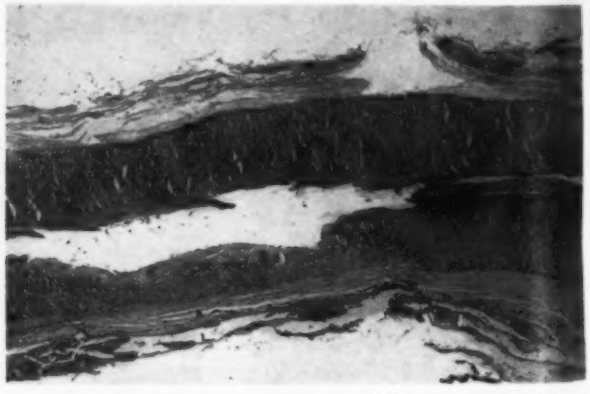


FIG. 668.—Artery occluded by a bulldog clamp with cloth covering, showing some intimal irregularity and damage, but less trauma than the preceding clamps.

dissection which has attended this method. As might be expected, the damage has been more linear in this case. Similarly, a degree of linear damage has followed the use of the narrow-bladed Potts clamp (*Fig.* 667) with division of the media

through most of its thickness but without any dissection.

The bulldog clamp is commonly used for medium-sized vessels. *Figs.* 668 and 669 show the results obtained with this clamp, its blades being covered by cloth and narrow rubber tubing respectively. In neither case has there been damage of the degree noted in the preceding methods and in particular there has been no disruption with dissection of the

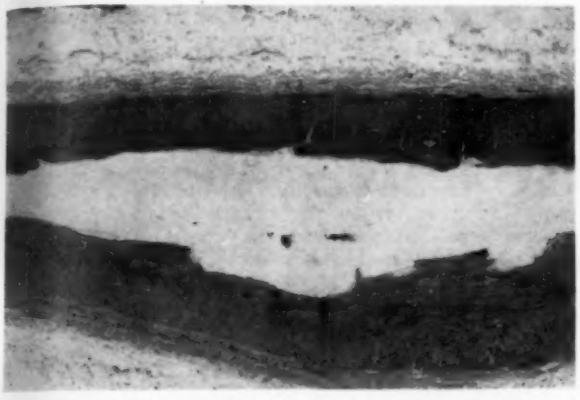


FIG. 669.—Artery occluded by bulldog clamp with rubber covering, showing some intimal damage but no gross trauma to the vessel wall.

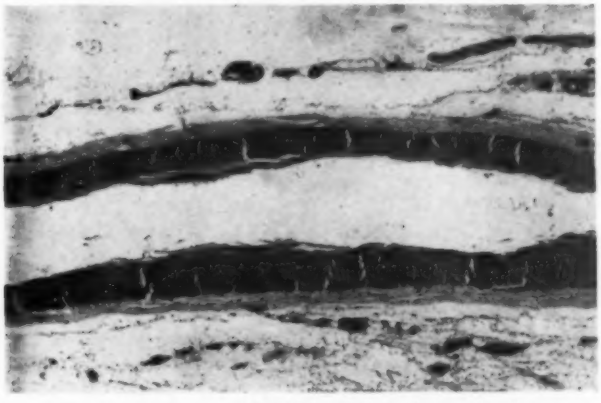


FIG. 670.—Artery occluded by Crile's clamp, showing little damage.

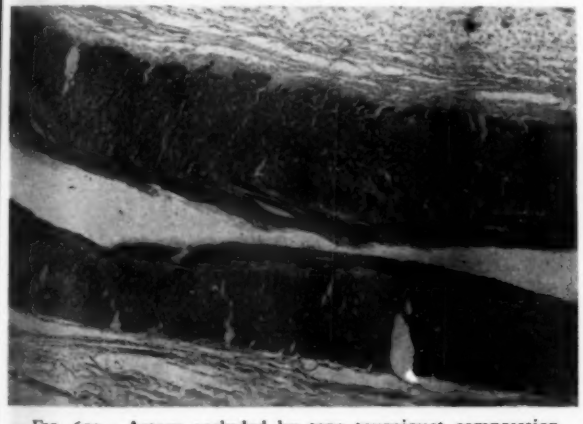


FIG. 671.—Artery occluded by tape tourniquet compression over rubber tubing, showing minimal damage.

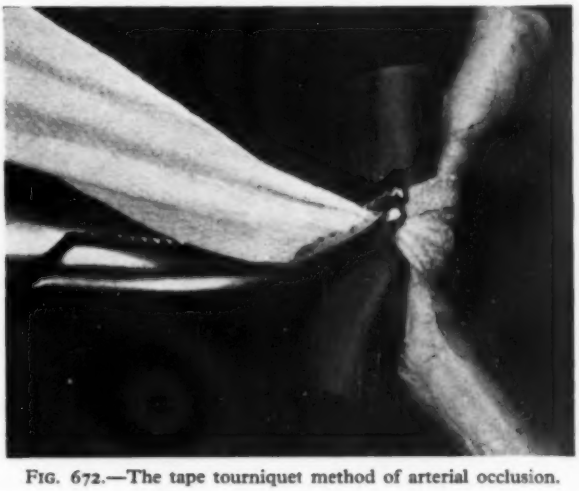


FIG. 672.—The tape tourniquet method of arterial occlusion.

media. Rubber covering of the blades seems slightly less traumatic than cloth covering, presumably due to the elasticity of the rubber. The Crile clamp also proved satisfactory; *Fig.* 670 indicates how minimal the damage has been. Occlusion by means of the tape tourniquet, a technique to be described below, produced results which withstand very favourably the closer scrutiny afforded by the somewhat higher magnification of *Fig.* 671.

SUMMARY OF RESULTS

Favourable Clamps	*Unfavourable Clamps*
Bulldog with rubber covered blades	Blalock
Bulldog with cloth covered blades	Craaford
Crile	Brock
Tape tourniquet	Ligation with silk over rubber tubing
	Potts

These findings are summarized under favourable and unfavourable categories in the accompanying table.

DISCUSSION

Repeated trials were undertaken and, while there was some slight variation in the results, two facts emerged: Firstly, those clamps in the unfavourable category were capable of producing considerable trauma, even if not constantly. Secondly, those clamps in the favourable class consistently produced only minimal damage. Moreover it seems likely that the differences can be related to variations in both the degree and nature of the arterial compression produced by the several methods.

The Craaford, Brock, and Potts clamps are all long-handled instruments through which considerable leverage can be exerted and consequently a harmful degree of vessel wall compression may result. The screw action which closes the blades of the Blalock clamp may similarly produce a traumatic degree of compression without the registration of this fact to the surgeon's fingers as he applies the instrument. Although it is possible to apply quite severe force while ligating a vessel with silk over rubber tubing, the failure of this method probably lies less in the

degree of compression than in its nature. Instead of being evenly distributed over a short segment of the artery it is all concentrated on a linear site, an additional objection to the Potts clamp.

Analysing the favourable results, it appears that the bulldog clamp owes its atraumatic character to the predetermined tension of the closed blades. This is the minimum compatible with satisfactory

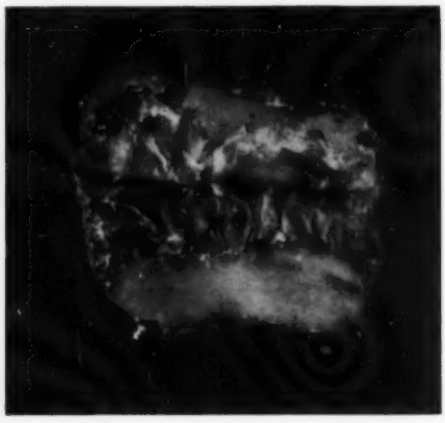


FIG. 673.—Segment of common femoral artery, showing disruption of intima by the Blalock clamp.

occlusion of the vessel and its constancy, allowing of no variation, prevents this minimum tension being exceeded. The broad flat surface offered by the Crile clamp and the short excursion of its blades without undue leverage similarly results in an atraumatic instrument. The application of the tape tourniquet will be described in detail and is illustrated in *Fig.* 672.

At the proposed site of occlusion the vessel is mobilized over a little more than half an inch of its course. A suitable length, usually about 18 in., of ½-in. tape is then moistened and passed beneath the artery, which is thus slung between the limbs of the tape. A 1-in. length of moderately soft rubber tubing of a diameter at least equalling the vessel is now laid lengthwise on its upper surface between the limbs of the tape. Tension is applied to these and at the same time they are clamped together flush with the upper surface of the rubber tubing, a cholecystectomy forceps proving convenient for this. The artery is thus occluded between the rubber tubing and the tape sling. The excess of rubber tubing can now be trimmed if it interferes with the operative field. Using this method it is mechanically impossible to exert too great a compression force upon the vessel, a fact borne out by the satisfactory sections repeatedly obtained during this study. Moreover the force is applied over a broad area of the arterial wall. Apart from being atraumatic, this simple tape tourniquet technique requires no special instruments and is therefore cheap and always readily available. An additional advantage is that the forceps used for clamping the tape can be applied at any angle and then laid flat if necessary, so that the operative field need never be obstructed as occasionally happens owing to the handles of some of the other clamps. Of the various clamps used, many were not intended for use on arteries as small as the gastro-epiploic. This, however, did not invalidate the point of the experiment, which was to determine the least traumatic of the commonly tried methods. The practical significance of this study is well illustrated by the following case.

CASE REPORT

A man aged 47 was admitted to our ward having sustained a laceration of the left groin with division of the common femoral artery, hæmorrhage having been controlled at another hospital by ligation. Examination showed the left leg to be cold, with absent pulses and urgently threatened vitality. An emergency operation was performed, when the ligated ends of the divided artery were resected and the continuity restored by insertion of an arterial homograft. During the anastomoses the host vessel above and below was occluded by Blalock's arterial clamps for a period of approximately an hour. 10,000 units of heparin were given during the operation.

The distal pulses failed to return and the survival of the limb was in doubt. Accordingly, the wound was re-opened and the graft explored. It was found to be non-pulsatile owing to occlusion of the host vessel both proximally and distally at the sites of application of the arterial clamps. The affected segments were excised, together with the intervening graft, and the vessel regrafted, using this time the tape tourniquet method of arterial occlusion. The distal pulses returned and with them the viability of the limb. Examination of the removed specimen showed the occlusion to be due to disruption of the vessel wall at the site of application of the clamps with subsequent dissection. *Fig.* 673 shows one end of the damaged host vessel where the intima has been disrupted by the clamp.

SUMMARY AND CONCLUSIONS

An investigation has been described whereby the traumatic effects of various arterial clamps were compared and a case reported of damage to the vessel wall caused by one of these clamps. The results have been recorded and the following conclusions reached. The tape tourniquet, and Crile and bulldog clamps produce the least damage in the series studied. We now use whenever possible the tape tourniquet for control of the larger vessels. For smaller arteries, such as the collaterals, we employ either the Crile or bulldog clamp, with a bias in favour of the latter as it is lighter and simpler to apply and remove.

We wish to express our thanks to the Pathology Department, under the direction of Professor D. M. Pryce, for preparing the sections; to Dr. K. J. Kingsbury, who was responsible for the photomicrographs; and to the Photographic Department of St. Mary's Hospital for the macroscopical photographs and the prints of the photomicrographs.

SQUAMOUS-CELL CYSTS OF THE THYROID

WITH SPECIAL REFERENCE TO THE AETIOLOGY OF SQUAMOUS EPITHELIUM IN THE HUMAN THYROID

BY H. M. GOLDBERG AND PETER HARVEY, MANCHESTER

SQUAMOUS epithelium is only rarely found in the human thyroid gland in health or disease. The occasional appearance of it has given rise to speculation regarding its aetiology. Small series of the rare squamous-cell carcinoma of the thyroid gland have been reported. Cases have also been described where small islands of squamous epithelium were accidentally found either at autopsy or in combination with another lesion of the thyroid gland. We have not found any reports in man of macroscopic cysts of the thyroid which were lined entirely by squamous epithelium. The following cases may, therefore, be of interest. They may also help to throw light on the still undecided question of the origin of these cells.

FIG. 674.—*Case* 1. The cyst is lined by squamous epithelium. Several islands of squamous cells can be seen in the wall. In the lower part of the figure are numerous degenerate thyroid acini. H. and E. (× 125.)

CASE REPORTS

Case 1.—Mr. F. F., aged 45, was admitted to the Manchester Royal Infirmary under the care of Mr. A. H. Southam in August, 1936, with a diagnosis of toxic adenoma of the right lobe of the thyroid gland. Bisection of the operation specimen showed nodular hyperplasia. There was a ' pseudo-adenoma ' within a fibrous capsule. Microscopy of the thyroid tissue within this capsule (*Figs.* 674, 675) showed areas of degeneration and hæmorrhage with some fibrosis. Also within the pseudo-adenoma was a cyst of irregular shape, lined by stratified squamous epithelium. This cyst was lying in an area of fibrosis infiltrated by chronic inflammatory cells. In this fibrous tissue there were also several islands of squamous cells. There were no signs of malignancy.

Case 2.—Mr. E. C., aged 24, who had been an epileptic for six years, was admitted to the Manchester Victoria Memorial Jewish Hospital on Feb. 12, 1953. He had noticed a lump in the left side of his neck for the past five years. It had recently increased in size but had not caused any inconvenience.

FIG. 675.—*Case* 1. Part of the main cavity of the cyst is shown in the left upper corner and a subsidiary process occupies the major part of the lower half of the figure. The fibrous tissue in which the cyst is lying is infiltrated by chronic inflammatory cells and contains apparently isolated groups of squamous cells. H. and E. (× 125.)

On examination the only abnormality demonstrated was a lump 1½ in. × 1½ in. in size in the left side of the neck, just lateral to the lower border of the thyroid cartilage. It was fluctuant, but not tender, and moved on swallowing. The thyroid gland was not enlarged and the trachea was not displaced. There were no signs of thyrotoxicosis.

The diagnosis of a cyst of the thyroid, possibly of the pyriform lobe, was made. At operation a bright yellow, thin-walled cyst (*Fig.* 676) was found lying on the medial aspect of the upper left lobe of the thyroid, and was excised with part of the upper pole of the gland.

PATHOLOGICAL REPORT.—A thin-walled cyst 1¼ in. × 1¼ in., to which were attached a few fragments of thyroid

tissue and muscle. Histological section (*Figs.* 677–680) shows the cyst wall to be lined by stratified squamous epithelium. It is partly surrounded by thyroid tissue and partly lying in muscle. There is also, lying away from the main mass of thyroid tissue, but near to the cyst, more thyroid tissue which is actually situated in between the voluntary muscle-fibres. Both the larger fragments of thyroid tissue and the group of acini lying between the muscle-fibres appear to be perfectly normal. Along the edge of the cyst where it lies in the thyroid gland, thyroid acini and small squamous cysts are intermingled. Some of these cysts are continuous with and open into the large cyst, whilst others resemble epithelial pearls. The large cyst contains amorphous debris with cholesterol clefts. There are no signs of any inflammatory process or fibrosis and no lymphoid tissue is seen.

FIG. 676.—*Case* 2. Appearance at operation. The bright yellow cyst can be seen on the medial surface of the left upper pole of the thyroid.

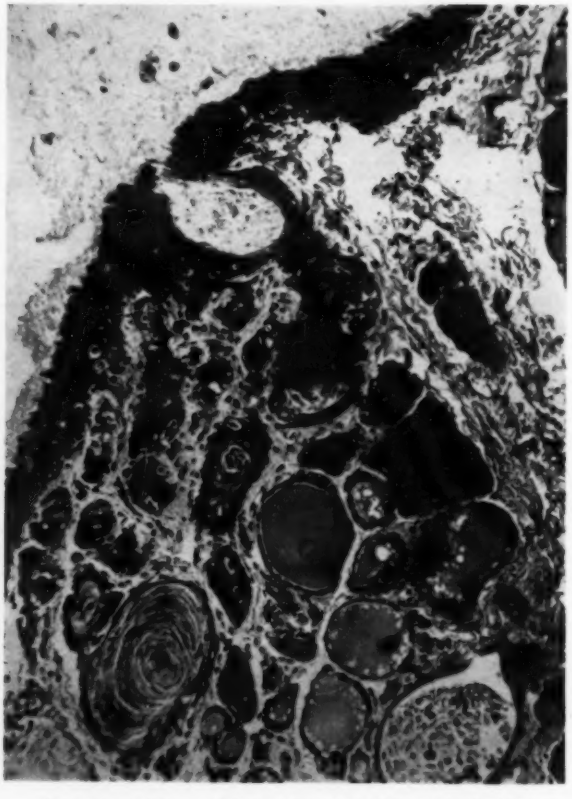


FIG. 677.—*Case* 2. The main cavity of the cyst is in the top left-hand corner, with one of the channels lined by squamous epithelium opening into it. Other squamous channels appear in transverse section amongst the normal thyroid acini and one of these channels is filled with concentric whorls of keratinous scales and resembles an epithelial pearl. H. and E. (× 110.)

DISCUSSION

The two cysts reported in this communication are simple cysts lined entirely by squamous epithelium. Similar cysts have been described in the cat (*Felis domestica*) by Mason (1931), in rats by Van Dyke (1944), in pigs by Badertscher (1918), in sheep by Van Dyke (1943), and in calves by Kingsbury (1935). We were unable to find any reports of similar cysts in man. Bale (1950) reviewed teratoma in the region of the thyroid gland. Six of the 61 cases presented were teratoma of the gland itself. Besides squamous epithelium they contained a large diversity of other tissue. The cysts reported by Crotti (1923) and Greene (1925) were lined by stratified squamous epithelium which contained sebaceous and sudiparous glands. They are true dermoid cysts lined by skin, whereas the cysts presented here are epidermoid cysts lined solely by squamous epithelium, without hair follicles or sweat-glands.

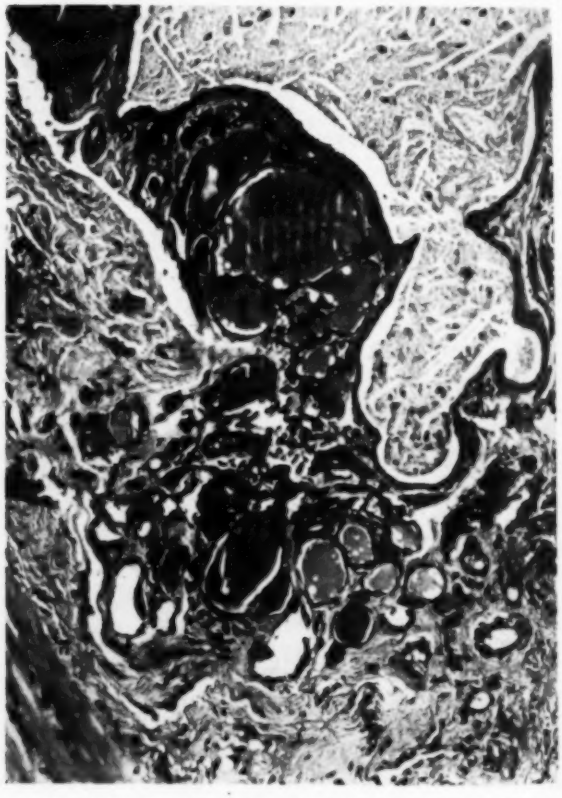


FIG. 678.—*Case* 2. A channel lined by squamous cells can be seen opening into the main cavity of the cyst. Thyroid acini and squamous channels are lying side by side. In the lower left-hand corner there are a few voluntary muscle-fibres. H. and E. (× 110.)

The theories regarding the origin of squamous epithelium in the thyroid gland postulate either a

metaplastic origin or a derivation from embryonic rests.

Epithelial metaplasia is usually assumed to take place in response to a call for altered function, or is the result of altered environment (Boyd, 1934). When islands of squamous epithelium are found in conjunction with pathological conditions of the thyroid gland, metaplasia of the normal thyroid epithelium seems a likely explanation for the appearance of the extraneous cells.

Wegelin (1926) described 3 cases of adenomatous goitre containing islands of squamous epithelium. One case had rudimentary hornification. Boyden, Coller, and Bugher (1931) found squamous epithelium in Riedel's disease. Jaffe (1937) reported 3 cases where islands of squamous epithelium were seen in association with sclerosis of the gland and 1 case in which they were associated with a metastatic abscess. There is, however, no cause for metaplasia in the thyroid of the neonates described in Getzowa's (1907) and Koeppel's (1910) series, where islands of squamous cells were found.

It has been suggested (Herrenschmidt, 1904; Berard and Dunet, 1924; Jaffe, 1937) that squamous-cell carcinoma arises in areas of epithelial metaplasia, but these authors offer no suggestion as to how that metaplasia had been brought about. It would seem to be highly unlikely that normal thyroid tissue would give rise to a squamous carcinoma. It is also improbable that neoplastic cells of squamous type should stimulate neighbouring thyroid tissue to undergo squamous metaplasia, as has been postulated by Jaffe. Neoplastic cells revert to a primitive cell type rather than take on the characters of a different adult cell. When a squamous-cell carcinoma occurs in other organs such as the gall-bladder or bronchus, the reason for the metaplasia is often evident. Calculi or chronic infection are frequent causes of this condition.

Wegelin found islands of squamous epithelium in surroundings similar to those of the squamous cyst in our first case. Both lay in areas of chronic inflammation with fibrosis and accumulations of leucocytes. If one considers how commonly degeneration and inflammation occur in the thyroid, but how rare is the finding of squamous cysts or islets, a metaplastic mechanism does not appear to be a satisfactory explanation for this occurrence.

Jaffe found appearances in one of his cases at the edge of the squamous carcinoma, which he cited as evidence for metaplasia. Some of the acini had the same configuration as the normal thyroid epithelium, but the cells lining the acini were of the squamous type. *Figs.* 677–679 represent sections from our second case. They show channels, lined by squamous epithelium, opening into the large squamous cyst. These same channels cut transversely would give the appearance Jaffe describes. They do in fact give this appearance in our sections (*Figs.* 677, 678) farther away from the cyst. These channels differ, therefore, from thyroid vesicles not only in the type of their epithelium, but also in their architecture. A metaplastic theory would not account for these differences.

Many authorities who have dealt with the histogenesis of squamous-cell carcinoma (Langhans, 1907; Kaufmann, 1922; Wegelin, 1926; Ewing, 1942; Clute and Warren, 1935) suggested an origin from the thyroglossal duct. Wenglowski (1912) put forward a modification of this theory when discussing the microscopic squamous cysts which he found in the line of the thyroglossal duct in the tongue and hyoid regions. He suggested that in its downgrowth the duct may include cells from the surface epithelium around the foramen cæcum, which may form squamous cysts. The upper end of the thyroglossal duct, when it remains patent, is usually lined by pavement cells. The middle portion, if it persists, is lined by ciliated epithelium. If secretion is retained in this portion of the duct, median cysts are formed at or below the hyoid bone, lined by squamous or cylindrical cells, often containing thyroid follicles in their walls. The lower portion of the duct, which forms the pyriform lobe of the fully developed

FIG. 679.—*Case* 2. A part of the wall of the main cyst is illustrated in which there are several large squamous channels, one of which contains whorls of keratinous scales. Between the squamous channels smaller thyroid acini can be seen. H. and E. (× 110.)

gland, becomes thyroid tissue. The pyriform lobe undergoes the same changes and is subject to the same pathological processes as the rest of the thyroid gland (Ewing, 1942). If squamous cells in the thyroid are derived from remnants of the thyroglossal duct these cells would be expected to occur more frequently in the pyriform lobe, which is derived from the more proximal portion of the thyroglossal duct. All the recorded instances of squamous-cell carcinoma and islets of squamous cells which we have studied have been situated in the lateral lobes.

FIG. 680.—*Case* 2. This microphotograph gives a high-power view of a squamous channel illustrated in the lower left-hand corner of *Fig.* 677. It shows the channel filled with concentric whorls of squames. Part of a small thyroid acinus can be seen in the upper left-hand corner. H. and E. (× 500.)

Schmidtmann (1919) reported a squamous-cell carcinoma of the thyroid in a boy aged 10. She believed that the cells originated from the branchial arches. It seems unlikely that our cases were branchial cysts. Their walls did not contain lymphoid tissue. The common branchial cysts, which arise from the second or third branchial arches, would not normally come in contact with the thyroid gland. Raven (1933) described a cyst derived from the fourth branchial pouch. It lay along the left side of the pharynx and œsophagus. It communicated with the lower part of the pharynx by a circular aperture situated in the fibres of the inferior constrictor, immediately behind the posterior border of the thyroid cartilage. The elongated connexion of the fourth branchial complex with the pharynx, the ductus pharyngobranchialis, usually disappears early after the severance of the complex from the pharynx. Its persistence enabled Raven to recognize the branchial nature of the cyst. His case differs from both our cases in that the cyst he reported lay outside the thyroid capsule, whereas ours both lay inside it.

Part of the fourth branchial complex, particularly its caudal pocket, the ultimo-branchial body, becomes incorporated in the growing thyroid gland (*Fig.* 681). It is believed to disappear early during the development of the human thyroid and to play no part in the formation of its final structure. The fate of the ultimo-branchial body has been extensively studied in a large number of mammals, where abundant material was available.

The cells composing this body are easily recognizable by the deep staining of the nuclei and the presence of a central cavity around which the cells of this body are grouped. In the cat (Mason, 1931), the pig (Badertscher, 1918), and the rat (Van Dyke, 1944), a large part of the ultimo-branchial body is included in the thyroid during its development and is often represented in the fully developed gland by cysts lined by squamous epithelium. Winniwarter (1933), working with guinea-pigs, and Van Dyke (1943), working with sheep, found that in these animals the ultimo-branchial body finally developed into a complicated assemblage of canals and cavities within the thyroid gland.

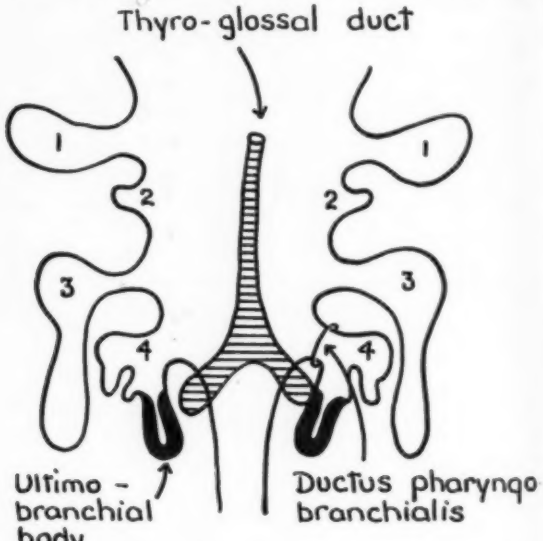


FIG. 681.—Schematic drawing of the pharyngeal pouches of an early human embryo. (*After Groschuff and Kohn in "Keibel and Mall".*)

In the human embryo Kingsbury (1939) was able to detect the cells of the body up to the 31-mm. stage, after which they seem to disappear completely. Only in one later embryo (36 mm.) could Kingsbury still detect a number of cells of ultimo-branchial origin. Kursteiner (1898) found appearances in 20-mm. human embryos which were similar to those reported by Winniwarter in guinea-pigs and by Van Dyke in sheep, which these authors traced to the ultimo-branchial body. He found channels and cysts in these thyroids which were arranged like an acinose gland. The channels were lined by cylindrical cells and the cysts by squamous epithelium.

Squamous cysts have been found in the thyroid of human embryos at a later stage of development. Groschuff (1900) reported a 44-mm. human embryo where a small cyst lined by squamous epithelium lay at the left lower pole of the thyroid and extended to the developing thymus IV. Herrmann and Verdun (1899) found a squamous cyst in the lower left side of the neck, medial to the thyroid gland in a 95-mm. human embryo. These cysts were situated where it might be expected to find remnants of the ultimo-branchial body. The left lobe of the thyroid would be the more common site as ultimo-branchial growth is often strikingly less or even absent on the right side in most mammals (Kingsbury). In this connexion it is interesting to note that Kocher (1908) stressed the fact that most squamous-cell carcinomata occurred in the left lobe of the thyroid.

The cyst in our second case has a number of similarities with the cysts found in animals, which owe their origin to the ultimo-branchial body and the cysts found in the human embryo. It was lined by squamous epithelium. The canals extending into the thyroid tissue are reminiscent of the canals which have been found in guinea-pigs and sheep, as well as the appearance found by Kursteiner in 20-mm. human embryos. Its situation at the medial side of the left lateral lobe of the thyroid is the exact situation where a remnant of the ultimo-branchial body would be expected.

CONCLUSION

After rejection of the metaplastic theory, we accepted a developmental explanation of the origin of squamous epithelium in the thyroid. This led us to a study of the possible origin from the thyroglossal duct or the fourth branchial complex. There seemed to us to be evidence in our second case which makes an origin from the ultimo-branchial body a likelihood. An ultimo-branchial origin of squamous cells in the thyroid has previously been suggested by Getzowa (1907), Koeppel (1910), and Meeker (1925).

We have been unable to find any recent account of the ultimo-branchial body in human embryos after the 35-mm. stage, and its ultimate fate is obscure. Any theory concerning the fate of this structure in the adult can only be regarded as an intriguing hypothesis. In view of the implications, especially with regard to the origin of squamous-cell carcinoma of the thyroid, reports of further work on the fate of the ultimo-branchial body in man will be awaited with interest.

We wish to thank Mr. A. H. Southam for his permission to publish his case; Dr. J. Davson for his helpful criticism and advice; and Miss J. Perry for her illustration and photomicrographs.

REFERENCES

BADERTSCHER, J. A. (1918), *Amer. J. Anat.*, **23**, 89.
BALE, G. F. (1950), *Amer. J. Path.*, **26**, 565.
BERARD, L., and DUNET, C. (1924), *Thyroidien.* Paris: Gaston Doin.
BOYD, W. A. (1934), *Textbook of Pathology*, 264. London: Henry Kimpton.
BOYDEN, A. M., COLLER, F. A., and BUGHER, J. C. (1931), *West J. Surg.*, **43**, 547.
CLUTE, H. M., and WARREN, S. (1935), *Surg. Gynec. Obstet.*, **60**, 861.
CROTTI, A. (1923), *Thyroid and Thymus*, 97. London: Henry Kimpton.
EWING, J. (1942), *Neoplastic Diseases*, 990, 995. Philadelphia: W. B. Saunders & Co.
GETZOWA, S. (1907), *Virchows Arch.*, **188**, 181.
GREENE, E. (1925), *Bol. Soc. Cirug. Chile*, **3**, 201.
GROSCHUFF, K. (1900), *Anat. Anz.*, **17**, 161.
HERRENSCHMIDT, A. (1904), *Thèse de Paris*, No. 225.
HERRMANN, G., and VERDUN, P. (1899), *C.R. Soc. Biol., Paris*, **51**, 853.
JAFFE, R. H. (1937), *Arch. Path. (Lab. Med.)*, **23**, 821.
KAUFMANN, E. (1922), *Lehrbuch der speziellen Anatomie.* Berlin: W. D. de Gruyter.
KINGSBURY, B. F. (1935), *Anat. Rec.*, **61**, 155.
— — (1939), *Amer. J. Anat.*, **65**, 333.
KOCHER, T. (1908), *Dtsch. Z. Chir.*, **91**, 197.
KOEPPEL, F. C. (1910), *Z. Beitr. Path. Anat.*, **49**, 579.
KURSTEINER, E. (1898), *Anat. Hefte.*, quoted by LANGHANS.
LANGHANS, T. (1907), *Virchows Arch.*, **189**, 69.
MASON, V. A. (1931), *Amer. J. Anat.*, **49**, 43.
MEEKER, L. H. (1925), *Amer. J. Path.*, **1**, 57.
RAVEN, R. W. (1933), *Brit. J. Surg.*, **21**, 235.
SCHMIDTMANN, M. (1919), *Virchows Arch.*, **226**, 100.
VAN DYKE, J. H. (1943), *Anat. Rec.*, **82**, 451.
— — (1944), *Ibid.*, **88**, 369.
WEGELIN, C. (1926), "Schilddruese", *Handbuch der speziellen pathologischen Anatomie u. Histologie* (Henke and Lubarsch), **8**. Berlin: J. Springer.
WENGLOWSKI, T. (1912), *Arch. klin. Chir.*, **98**, 150.
WINNIWARTER, H. (1933), *Arch. Biol.*, **44**, 741.

HYPOTHERMIA AS AN AID TO SURGERY*

BY D. N. ROSS
GUY'S HOSPITAL, LONDON

BY hypothermia is generally meant the reduction of the body temperature from normal to the region of 25° C. (77° F.). Temperatures much lower than this, and even below 0° C. (Smith, Lovelock, and Parkes, 1954), have been attained in experimental animals, but until more is known of the altered physiology at low temperatures, cooling below 25° C. is probably not justified in man.

The aim of hypothermia is to reduce tissue metabolism and oxygen requirements to such a degree that susceptible tissues such as the heart and central nervous system will be able to withstand partial or total exclusion from the circulation for prolonged periods without suffering anoxic damage.

Cooling of human cases was first used by Temple Fay in America in 1940 as a therapeutic measure in

* A paper delivered at a meeting of the Section of Surgery of the Royal Society of Medicine held at Guy's Hospital on April 30, 1954.

cases of advanced malignant disease, and about the same time by Talbott (1941) in the treatment of schizophrenia. Neither of these applications gave

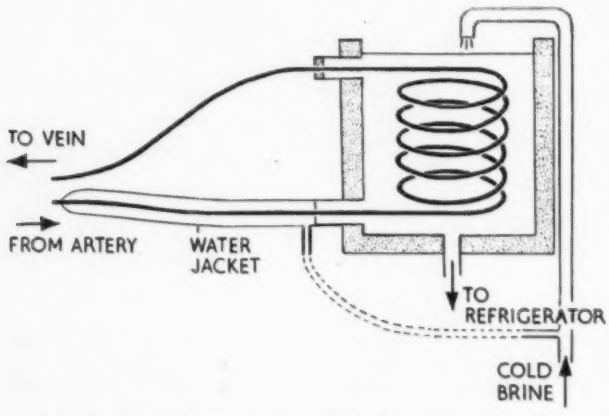


FIG. 682.—Sketch showing principle of blood-cooling coil.

surgery within the heart. On the other hand further reductions in temperature to 12° C. or lower, if this can be accomplished safely, may allow enough time for unhurried intracardiac manœuvres, with the added advantage of an asystolic heart.

The surgery of the great vessels should be facilitated by the use of hypothermia because of the reduced blood-pressure, and formerly inaccessible aneurysms of the arch and descending thoracic aorta can now be resected without damage to the brain or cord. Renal and mesenteric vessels can be clamped for at least an hour under these conditions (Delorme, 1952), and clamping of the blood-supply to the liver may facilitate the resection of secondary deposits in that organ.

Neurosurgery should benefit, since it appears possible to clamp off the blood-supply to the cooled brain for about fifteen minutes, and this should be of value in dealing with hæmorrhage from aneurysms at the base of the brain. Other fields in which hypothermia may find an application include

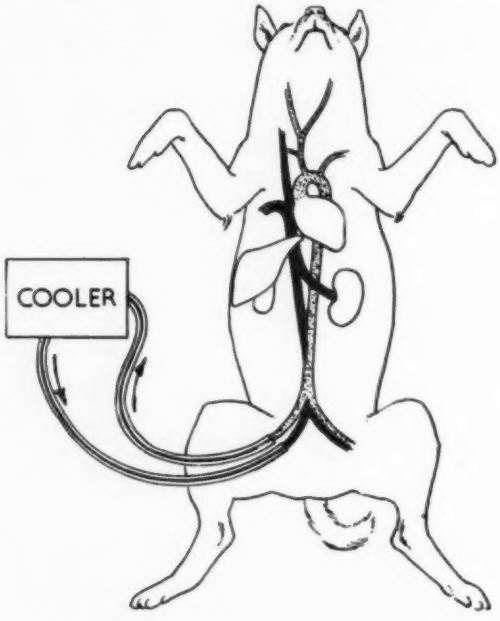


FIG. 683.—Diagram shows the direction of the blood-flow in the arteriovenous cooling technique.

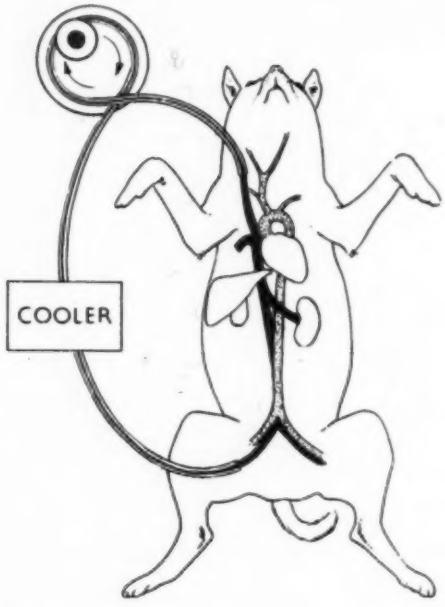


FIG. 684.—In venous cooling blood is pumped from the superior vena cava and returned cool to the inferior vena cava.

encouraging results. Present-day interest in hypothermia arises from the work of Bigelow, Callaghan, and Hopps (1950). They were able to show that the heart could be excluded from the circulation of cooled dogs for fifteen minutes with recovery, and subsequent workers have aimed at applying this technique to cardiovascular surgery in man.

The principal application of the method appears to be in the field of cardiac surgery, where the development of the artificial heart-lung has not been able to keep pace with the requirements of the cardiac surgeon as regards the provision of a dry operative field within the heart. This can be achieved in the hypothermic heart by clamping off the great veins for a limited period, but it is possible that a combination of hypothermia with a very much simplified artificial heart will in future allow more time for hyperthyroidism, severe shock, and in the management of extensive burns, but these possibilities have still to be explored.

METHODS

Methods of inducing hypothermia include surface cooling by the application of ice, ice-water, or refrigerated blankets to the skin, or blood-stream cooling in which the blood is cooled in an extracorporeal circuit and returned cold to the body (*Fig.* 682). The so-called artificial hibernation produced by injecting a mixture of drugs constituting the lytic cocktail, does not result in a fall of temperature of more than 1–2°, depending on the environmental temperature.

Surface cooling is easy to apply, but it exposes the skin, subcutaneous tissues, and nerves to

temperatures near freezing-point. In addition, the rate and depth of cooling are difficult to control. On the other hand blood-stream cooling provides a means of rapid cooling with accurate control, and no tissue is subjected to temperatures near freezing-point. In addition it offers the advantage of enabling

FIG. 685.—A photograph of the refrigerator unit built at Guy's. This maintains the temperature of the refrigerant solution surrounding the blood coil at a thermostatically controlled level.

the surgeon to proceed with the operation while the cooling is proceeding, and since prolonged cooling appears to be associated with an increased mortality in experimental animals, this technique reduces the period of hypothermia.

In 120 dogs and 5 human cases the cooling of the blood was carried out by the method of arteriovenous cooling (Delorme, 1952; Boerema, Wildschut, Schmidt, and Broekhuysen, 1951, Ross, 1954 a). In this technique the arterial blood is led from the superficial femoral artery through a 9–10 ft. length of plastic tubing and back into the femoral or saphenous vein. The coil is surrounded by a refrigerant solution and the blood is kept circulating through the coil by the beating of the heart (*Fig.* 683). This is a very satisfactory technique experimentally, but in applying it to human cases with heart disease certain disadvantages have become evident.

As cooling proceeds the cardiac output falls and the circulation through the coil slows, so that the rate of cooling becomes progressively slower. Again it is a disadvantage to cannulate a major artery in a patient, for, in spite of excision and careful end-to-end suturing, at least two patients have thrombosed superficial femoral arteries. Finally the effect of the arteriovenous fistula through the coil is to cause a slight fall in diastolic pressure, and in congenital hearts with a septal defect this may precipitate or reverse a shunt.

Consequently a system of venous cooling has been developed (Ross, 1954 b), in which blood is extracted from a cannula passed into the superior vena cava and pumped by simple rotary pump through a similar cooling coil and back into the inferior vena cava (*Fig.* 684). In this way no artery is interfered with and there is no arteriovenous fistula. Also the rate of cooling is maintained, since the flow of blood from the pump is constant.

Other investigators use a heart-lung apparatus with a cooling coil in the circuit (Gollan, Hamilton,

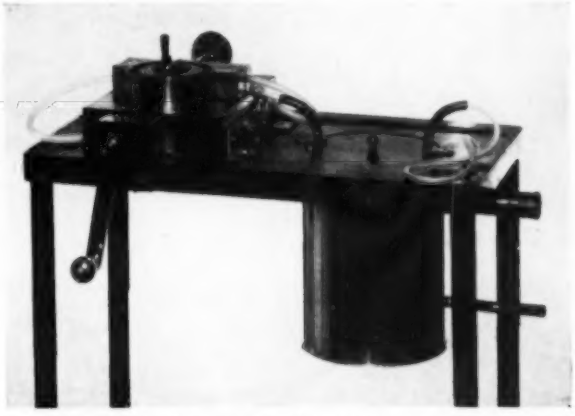


FIG. 686.—The venous cooling apparatus consisting of a simple rotary pump and blood-cooling coil in an insulated tank.

and Meneely, 1954; Juvenelle, Lind, and Wegelius, 1954). Such a system may allow a longer period of open heart work while the circulation is maintained, but it does introduce the hazards and complexities of the artificial circulation.

In developing apparatus suitable for use in the operating theatre a number of additions and modifications have been made to the original cooling coil. These have been dictated by the need for maintaining sterility and avoiding anæsthetic explosions (*Figs.* 685, 686).

TECHNIQUE

Dogs and human cases receive a standard premedication, and this reduces the amount of subsequent anæsthetic required to maintain anæsthesia. Pentothal is used for induction and small intravenous doses are repeated in dogs to prevent shivering, although this is rare in blood-stream cooling. In human cases a relaxant is used for this purpose. An important function of the anæsthetist is to maintain regular and adequate ventilation in order to combat the respiratory acidosis which will otherwise occur from the increased solubility of carbon dioxide in blood at low temperatures.

During cooling, temperatures are recorded by means of thermocouples or thermometers in the rectum and pharynx, and blood-pressure and pulse-rates are recorded at ten-minute intervals. E.C.G. tracings are useful in giving warning of impending ventricular fibrillation, as this is usually preceded by conduction disturbances.

In arteriovenous cooling the femoral vessels are exposed in the groin and cannulated after an injection of papaverine to minimize spasm. Cooling

commences immediately the clamp controlling the femoral artery is released and can be stopped at any stage by simply reclamping the artery. In venous cooling the saphenous vein is cannulated first and then the superior vena cava via the external jugular vein or both vena cavæ are cannulated via the right atrial appendage if the chest is open. Cooling commences as soon as the pump is set in motion. No heparin is used in either circuit, since the effect of cold is to prolong the clotting time of blood

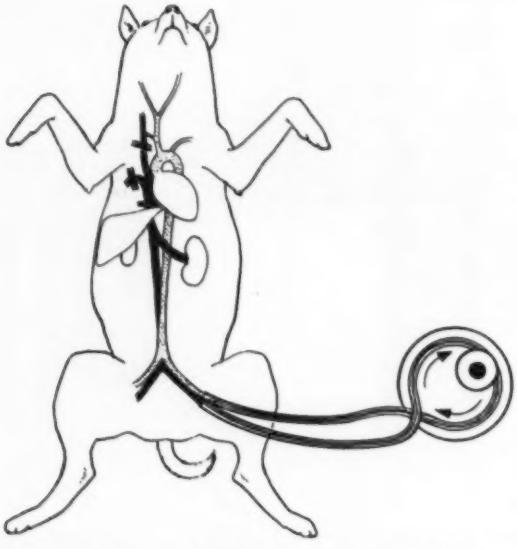


FIG. 687.—An experimental method for maintaining the blood-pressure during exclusion of the heart

(Ross, 1954 c). In addition, not more than about 60 c.c. of blood are in the extracorporeal circuit at a time.

When the required temperature is reached, cooling is stopped and the entire cooling apparatus is removed from the theatre. The temperature will not fall farther as in surface cooling, but rises fairly quickly at first, after which it stabilizes and rises slowly over the next three to four hours, depending on the temperature of the environment.

The great veins are isolated and clamped, after which the heart empties and becomes flabby but continues to beat. Under these conditions the heart can be opened for 7 to 10 minutes before ventricular fibrillation is likely to supervene, but if a cardiotomy is not done it can be excluded from the circulation for 20 minutes or more, with recovery in dogs.

After closure of the heart and release of the veins, the venous blood is rewarmed while the chest is closed. Various rewarming methods have been investigated including blood-stream rewarming, radio-frequency rewarming (Bigelow, Hopps, and Callaghan, 1952), and rectal rewarming by means of the circulation of hot water confined within a length of Paul's tubing lying in the rectum. The aim has been to conduct heat to the deep tissues without causing a peripheral cutaneous vasodilatation.

In order to prolong the time that the heart may be clamped off and to prevent coronary air embolism, attempts have been made to perfuse the arterial tree during the period of exclusion of the heart. In animals this has been accomplished by simply reversing the circulation and perfusing the arterial tree with the animals' own venous blood (Ross, 1954 a) (*Fig.* 687). The use of venous blood is possible for a limited period, since this has an increased oxygen content under hypothermic conditions and at the same time the oxygen requirements of the tissues are low. Juvenelle and others (1954) combine the advantages of hypothermia with the use of an artificial heart-lung apparatus for the same reason.

PHYSIOLOGICAL OBSERVATIONS

A number of alterations in the normal body physiology have been observed during the course of these investigations, and it is clear from the results so far obtainable that the physiology of the hypothermic animal deserves very close study. In particular it must be established that the changes observed are truly reversible, with no permanent pathological alterations in cell structure or function. An observation of importance has been the fact that prolonged hypothermia is less likely to be followed by recovery, and this may be related to irreversible changes within the cell.

Changes in blood-pressure pulse, and respiration have been recorded by numerous observers. The pulse-rate slows in direct linear relationship with the degree of cooling, but the blood-pressure is maintained in the early stages of cooling. At 25° C. the pulse is likely to vary between 60 and 80 per minute and the blood-pressure is generally about 80 mm. systolic. In the early stages of cooling respirations may increase in frequency, but they soon diminish in both frequency and amplitude, so that they finally stop or become inadequate at any time after the temperature is below 30° C., depending on the degree of depression of the respiratory centre by the anæsthetic agent being used.

The clotting time of the blood is increased by cooling, and this is of value in that it avoids the necessity of heparinizing the blood in the cooling coil, but at the same time it is not a source of embarrassment to the surgeon as regards hæmostasis.

Oxygen consumption and cardiac output fall linearly provided that shivering is prevented, and at 25° C. the oxygen consumption has fallen to about 25 per cent of normal. On the other hand the consumption of oxygen may rise by 200 per cent if violent shivering occurs. The oxygen content of the arterial and venous blood actually increases owing to the increased solubility of the gas in cold blood, and this increase, together with the reduced requirements of the tissues, means that there is a relative excess of oxygen available under conditions of hypothermia.

Measurements of hæmatocrit have been interesting and seem to give a clue to some marked alteration in the distribution of the body fluids. The hæmatocrit invariably rises with cooling, often by as much as 10 per cent. This cannot be accounted for by a splenic contraction, since a similar rise has been recorded in splenectomized animals. Serum-potassium and sodium and blood-sugar do not alter appreciably, but if dextrose is given intravenously

the blood-sugar may rise considerably, no doubt owing to the absence of metabolism of glucose by the cold liver. Measurements of the distribution of fluid in the extracellular body compartments present many difficulties under hypothermic conditions, but the ratio does not seem to be seriously disturbed unless the stage of cooling is prolonged.

The blood reaction during cooling indicates the development of an acidosis, and since this may be responsible for secondary alterations in electrolyte ionization and may be a factor in the increased irritability of the cold myocardium, it is important for the anæsthetist to guard against the development of a respiratory acidosis by maintaining free elimination of carbon dioxide through regular and adequate ventilation.

Electrocardiograph tracings have been taken during cooling and rewarming, and these have been useful in giving warning of impending ventricular fibrillation. The development of atrial fibrillation, heart-blocks, or slurring of the QRS and flattening or inversion of the T wave have been particularly significant.

The tendency to ventricular fibrillation is the great drawback to hypothermic surgery, but it must be remembered that under these conditions cerebral damage is unlikely to occur for ten to fifteen minutes, so that there is a wider margin of safety and consequently more time for restoration of the circulation by massage and electrical defibrillation.

CONCLUSIONS

Hypothermia is a potentially valuable aid to surgery and enables cardiac surgeons to perform operations which would otherwise be impossible. Its use at present should probably be restricted to this type of case and its wider application should await further elucidation of the physiological problems encountered. Its widespread employment is likely to add an additional hazard to routine operations, and, by increasing the overall mortality, is likely to bring the method into disrepute.

REFERENCES

BIGELOW, W. G., CALLAGHAN, J. C., and HOPPS, J. A. (1950), *Ann. Surg.*, **132**, 849.

— — HOPPS, J. A., and CALLAGHAN, J. C. (1952), *Canad. J. med. Sci.*, **30**, 185.

BOEREMA, I., WILDSCHUT, A., SCHMIDT, W. J. H., and BROEKHUYSEN, J. (1951), *Arch. chir. Neerl.*, **3**, 25.

DELORME, E. J. (1952), *Lancet*, **2**, 914.

FAY, T. (1940), *N.Y.St. J. Med.*, **40**, 1351.

GOLLAN, F., HAMILTON, E. C., and MENEELY, G. R. (1954), *Surgery*, **35**, 88.

JUVENELLE, A. A., LIND, J., and WEGELIUS, C. (1954), *Amer. Heart J.*, **47**, 692.

ROSS, D. N. (1954a), *Guy's Hosp. Rep.*, **103**, 97.

— — (1954b), *Lancet*, **2**, 1108.

— — (1954c), *Guy's Hosp. Rep.*, **103**, 116.

SMITH, A. U., LOVELOCK, J. E., and PARKES, A. S. (1954), *Nature, Lond.*, **173**, 1136.

TALBOTT, J. H. (1941), *New Engl. J. Med.*, **224**, 281.

GASTRIC TUBERCULOSIS ASSOCIATED WITH GASTRIC CARCINOMA

BY N. C. TANNER AND B. F. SWYNNERTON

ST. JAMES'S HOSPITAL, LONDON

CANCER may be influenced by its environment. Growths of the skin or mucous membranes are often invaded by pyogenic organisms which alter their gross appearances and influence the symptoms and clinical course. Another illustration is the peptic digestion which may occur in gastric neoplasms.

The stomach is very seldom affected by tuberculosis, and this has been attributed to the bacteriocidal action of hydrochloric acid and pepsin. Experiments quoted by Broders (1917), however, suggest that tubercle bacilli are not killed by gastric juice, although they may be attenuated by several hours' contact with it. Another possible explanation is the sparsity of lymphoid tissue in the stomach wall. Dürck (1895) has suggested that a break in the continuity of the gastric mucosa as a result of erosion, ulcer, or neoplasm is necessary for tuberculosis to gain a foothold. The most likely explanation, then, of the combination of cancer and tuberculosis in the stomach is that they are instances of secondary tuberculous infection of a gastric cancer.

Gastroscopic examination of patients suffering from pulmonary tuberculosis rarely shows any specific tuberculous lesion of the stomach, and, if a simple ulcer is present, it does not appear to vary from simple peptic ulcer as seen in the non-tuberculous patient.

Broders (1917) laid down very strict criteria for the diagnosis of gastric tuberculosis. For a positive diagnosis he required the demonstration of tubercle bacilli in a histologically tuberculous lesion, or of tubercle bacilli in the depths of an indefinite histological lesion. For a probable diagnosis he required a good histological appearance without the presence of bacilli. All other cases he rejected as doubtful.

Clagett and Walters (1938) were able to collect from the literature the records of 368 patients whom they considered to be proven or probable cases. Amongst these there were 30 in whom there were associated gastric neoplasms. Since that time cases of tuberculosis of the stomach have been reported fairly regularly and a comprehensive review of the condition in children has been given by Binder, Ruby, and Shuman (1945). Several further cases of gastric tuberculosis in association with gastric carcinoma have been described, and also 1 case with a leiomyoma by Sechi (1944). A case associated with gastric lymphosarcoma had previously been published by Rentschler and Travis (1934). Gastric tuberculosis combined with gastric carcinoma has recently been seen in a patient treated at St. James's Hospital, London. His story is as follows :—

CASE REPORTS

Case 1.—A railway fitter, aged 43, was admitted to hospital on Jan. 30, 1951, complaining that for three years he had had periodic attacks of epigastric pain which came on immediately after eating. During the five months before admission the pain had become more severe and had radiated through to the back. Vomiting relieved the pain but there was no relief from eating and little from

FIG. 688.—*Case* 1. Gastric carcinoma and tuberculosis showing serosal appearances at time of operation, including central 'pustule' and enlarged regional lymph-nodes.

alkalis. His appetite was good, but, despite this, there had been much loss of weight. A diagnosis of bilateral apical pulmonary tuberculosis was made at the time of onset of gastric symptoms and he had been under surveillance as an out-patient at a sanatorium.

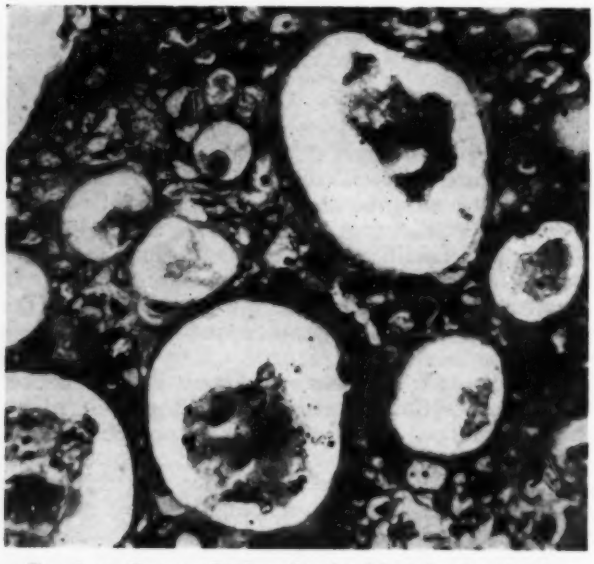


FIG. 690.—*Case* 1. Section of regional lymph-node showing adenocarcinoma.

ON ADMISSION.—He was pale and emaciated. A firm mass was palpated in the epigastrium and gastric peristalsis was visible.

A chest radiograph showed fibrocaseous tuberculosis in both upper zones; X-ray examination after a barium meal showed a normal œsophagus. There was gastric stasis with a large residue and no barium was seen to enter the duodenum. Gastroscopy suggested the presence of an antral neoplasm or ulcer. A fractional test-meal using gruel as the stimulant revealed complete achlorhydria. Repeated sputum examinations (fifteen) failed to show tubercle bacilli.

AT OPERATION.—In view of the above findings a laparotomy was performed on Feb. 22. A small quantity of free fluid was found in the peritoneal cavity. A large soft infiltrative lesion extended from 2 in. below the cardia to the pylorus. In the centre of this there was a small yellow subserosal pustule (*Fig.* 688). There were many

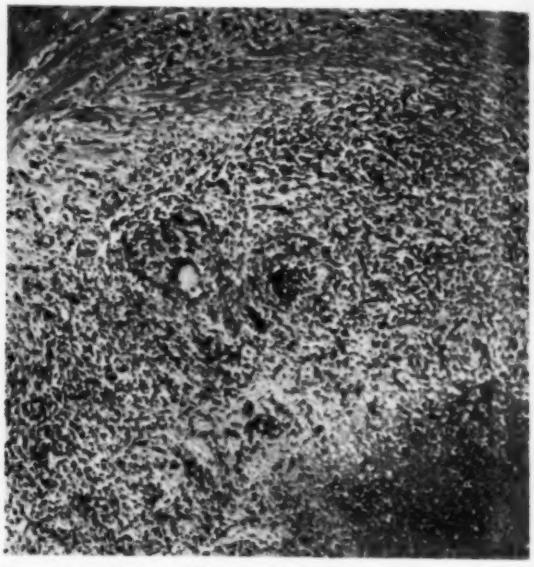


FIG. 689.—*Case* 1. Section of serosal 'pustule' showing giant-cell system.

large caseating glands in the greater and lesser omenta and several soft peritoneal masses in the pelvis. Similar masses were present in the liver. A high retrocolic posterior gastrojejunostomy was performed and biopsies were taken of the gastric mucosa and subserosa, the liver, and a pyloric lymph-node. Streptomycin was applied locally before closing the abdomen.

PATHOLOGY.—Section of the gastric mucosa showed fibrosis of the mucosa with some distortion of the gastric glands. The serosa showed caseation with some giant-cell systems suggesting a tuberculous granuloma (*Fig.* 689). Sections of the pyloric lymph-gland showed typical tuberculous foci with adenocarcinoma on the periphery in the sinuses (*Fig.* 690). Sections of the liver showed typical tuberculous foci.

The patient was put on to streptomycin and para-amino salicylic acid, but the lattter was discontinued for a period owing to the development of an urticarial rash. Convalescence was uneventful and he was discharged from hospital on May 7, 1951, to continue chemotherapy at home. Before discharge three further gastroscopic examinations were carried out which showed a finely granular white-based ulcer with hæmorrhages in the base extending from 1 in. below the cardia to the angulus. The edge was regular, congested, and slightly raised, and continued into the antrum. The ulcer gave the impression of healing in some parts. The gastro-enterostomy appeared normal.

PROGRESS.—The patient was seen again in June, 1951, when he was feeling well and had gained nearly 1 st. in weight. Arrangements were made for a further gastroscopic examination, but he failed to attend and was not seen again until December, when he attended the out-patient clinic with melæna. The mass in the epigastrium was unchanged. A radiograph of a barium meal failed to show up the distal portion of the stomach, but the stoma was functioning well. Radiography of the chest showed little change in the fibrosis in both upper zones.

ON RE-ADMISSION.—He was re-admitted to hospital on Jan. 28, 1952, complaining of constant epigastric pain radiating through to the back and of frequent hiccup. On examination he was pale and wasted. In addition to the tender mobile mass in the mid-epigastrium there was a soft palpable spleen. Rectal examination suggested the presence of a mass in the rectovesical pouch. In the chest there were abnormal signs at both apices and evidence of cavitation on the right. Specimens of sputum and gastric juice showed no acid-fast bacilli. His condition deteriorated rapidly and he died on Feb. 26.

AT AUTOPSY.—The gastric carcinoma was found to be invading the colon, pancreas, and liver. Both the pylorus and the gastro-enterostomy stoma were patent, but narrowed and surrounded by growth. In the stomach the tumour had produced villous frond-like proliferations of the mucosa. The peritoneum was studded with tuberculous foci and neoplastic deposits, and in the liver there were numerous small lesions which appeared to the naked eye to be tuberculous in origin. In the chest there was bilateral apical fibrocaseous tuberculosis, and at the bases septic bronchopneumonia with some fibrosis. There was an early tuberculous meningitis.

Discussion.—The presence of tuberculous nodules in the liver is occasionally met with during laparotomy. Care must be taken not to confuse them with secondary malignant conditions and they also have to be differentiated from peritoneal cysts, gummata, hepatoma, and hæmangiomata. Such tuberculous lesions usually result from a past portal pyæmia and may originate from any part of the portal system. At times they may be found when dealing with non-tuberculous gastro-intestinal affections, and, if quiescent, no special attention need be paid to them. The possibility of gastric or duodenal tuberculosis should, however, be borne in mind when a gastric or duodenal lesion is found in association with an obvious tuberculous lesion elsewhere. In most such cases the two conditions will be unconnected, as is illustrated by the following case :—

Case 2.—A lorry driver's mate, aged 47, was admitted to hospital on March 2, 1949, with a history of two years' epigastric pain coming on two hours after meals and relieved by alkalis, but not by food. There had been no remissions and during the week before admission the pain had become constant and was associated with frequent vomiting. Radiography of a barium meal showed an irregular duodenal cap, and a large calcified shadow was demonstrated in the right hypochondrium (*Fig.* 691). An X-ray film of the chest showed no abnormality.

He failed to settle down on medical treatment and at operation on March 22 typical anterior and posterior duodenal ulcers were found. In addition about ten hard masses ranging in diameter from 0·4 to 1·5 cm. were found on the surface of the liver attached to the parietes by adhesions. Two of these nodules were removed for section, and the duodenal ulcers were treated by subdiaphragmatic vagotomy. Convalescence was uneventful. Microscopy of the hepatic nodules suggested that they were old tuberculous lesions. He has been contacted five years after the operation and, apart from mild post-vagotomy symptoms, is very well.

The difficulties in interpretation of the radiological appearances of gastric tuberculosis have been stressed by Ackermann (1940), and it is unlikely that the diagnosis will be made before operation or necropsy or the microscopical examination of resected material.

Records of 34 cases of gastric tuberculosis associated with gastric neoplasms have been found in the literature. Since all are very similar it has not been considered necessary to tabulate them, though a bibliography is given. The patient is most commonly a man aged over 40 years who presents with symptoms suggestive of gastric carcinoma.

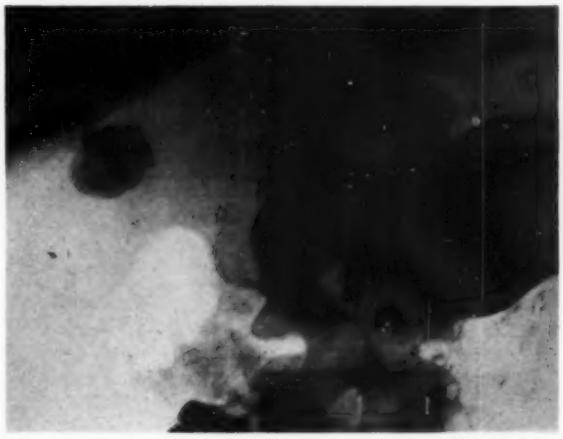


FIG. 691.—*Case* 2. Radiograph of barium in the stomach, showing relationship to calcified mass in liver.

Frequently there is either a history of pulmonary tuberculosis or an obvious tuberculous lesion is found on investigation.

A study of the recorded cases shows that enlarged regional lymph-nodes or even deposits in the liver may be due to tuberculosis alone and not to metastatic carcinoma. It is advisable, therefore, whenever possible to resect the gastric lesion and afterwards to treat the patient as though he had uncomplicated tuberculosis. There are as yet too few recorded cases to estimate the chances of prolonged survival.

Most authorities are agreed that carcinoma will not invade caseating tissue, so the finding of caseating glands suggests that they may be free from growth. It is interesting to speculate whether invasion of a malignant lesion by tuberculosis may bring about local cure of the cancer. The need for careful histological assessment is emphasized by the work of Symmers (1951), who describes tuberculoid cellular reactions to cancer which might easily be mistaken for tuberculosis.

It was at one time considered that tuberculosis and malignant disease were mutually antagonistic. The reviews of Broders (1919) and Cooper (1932) suggest that this is not so, though the conditions are very rarely encountered together. A recent paper by Hedberg, Graham, and Wierman (1951) on the co-existence of pulmonary tuberculosis and bronchial carcinoma suggests that the involvement of the lungs by the two diseases is not so uncommon as was previously thought. They attribute this finding to the fact that pulmonary tuberculosis is now more frequently seen in older people. In so far as other organs are concerned, we agree with Clagett and Walters (1938) that the concurrence of cancer and tuberculosis is a pathological curiosity which is of interest not only on account of its rarity, but also on account of the difficulties of diagnosis and treatment.

We are indebted to Miss E. Mason and Mr. R. J. Parris for the photographs and to Dr. G. Allen and Dr. R. Quilliam for the pathological and radiological reports, respectively.

BIBLIOGRAPHY

ACKERMANN, A. J. (1940), *Amer. J. Roentgenol.*, **44**, 59.

ADAMCSIK, F., and ERDÉLY, J. (1942), *Chirurg*, **14**, 304.

ANSCHUTZ, A. W., and KONJETZNY, G. (1921), *Die Geschwulste des Magens*, **2**, 240. Stuttgart: Enke.

BARCHASCH, P. (1907), *Beitr. Klin. Tuberk.*, **8**, 225.

BASTEDO, W. A. (1904), *Med. News*, **85**, 1165.

BAUMGARTNER, W. (1938), *Beitr. Klin. Chir.*, **167**, 211.

BINDER, I., RUBY, V. M., and SHUMAN, B. J. (1945), *Gastroenterology*, **5**, 474.

BORRMAN, R. (1900), *Mitt. Grenzgeb Med. Chir.*, Supp. 1, 73.

— — (1926), *Handbuch der Speziellen Pathologischen Anatomie und Histologie* (Henke and Lubarsch), IV, Pt. 1, 1000. Berlin: Springer.

BORST, M. (1902), *Die Lehre von den Geschwulste*, **11**, 763. Wiesbaden: Bergmann.

BRODERS, A. C. (1917), *Surg. Gynec. Obstet.*, **25**, 490.

— — (1919), *J. Amer. med. Ass.*, **72**, 390.

CLAGETT, O. T., and WALTERS, W. (1938), *Arch. Surg., Chicago*, **37**, 505.

CLAUDE, H. (1899), *C.R. Soc. Biol., Paris*, **51**, 40.

CLEMENT, G. (1895), *Virchows Arch.*, **139**, 35.

COLLINSON, H., and STEWART, M. J. (1927), *Brit. J. Surg.*, **15**, 626.

COOPER, F. G. (1932), *Amer. Rev. Tuberc.*, **25**, 108.

DÜRCK, H. (1895), *Ergb. allg. Path. path. Anat.*, **2**, 334.

EUSTERMAN, G. B., and BALFOUR, D. C. (1935), *The Stomach and Duodenum*, 659. Philadelphia and London: Saunders.

FALTIN, R. (1927), *Acta chir. scand.*, **61**, 331.

FENGER, E. P. K., and PETTER, C. K. (1929), *Minnesota Med.*, **12**, 271.

FORMAN, J., and CAMERON, H. (1917), *Insterst. med. J.*, **24**, 1033.

FRANK, G. (1914), *Arb. path. Anat. Bakt.*, **8**, 172.

HAMMESFAHR, C. (1948), *Zbl. Chir.*, **73**, 593.

HAMPERL, H. (1926), *Z. Krebsforsch.*, **23**, 430.

HARBITZ, F. (1927), *Norsk. Mag. Laegevidensk.*, **88**, 572.

HEDBERG, G. A., GRAHAM, G. G., and WIERMAN, W. H. (1951), *Minnesota Med.*, **34**, 972.

HURST, A. F., and STEWART, M. J. (1930), *Guy's Hosp. Rep.*, **80**, 445.

JIMENEZ-DIAZ, C., MORALES PLEGUEZUELO, M., and MARINO, C. (1942), *Rev. clin. esp.*, **4**, 319.

LÖWENHEIM, B. (1897), *Über die Atiologischen Beziehungen Zwischen Tuberkulae and Carcinom.* Leipzig.

LYLE, H. H. M. (1913), *Amer. J. med. Sci.*, **145**, 691.

MELCHIOR, L. (1913), *Beitr. Klin. Tuberk.*, **26**, 185.

METTERHAUSEN, B. (1897), *Ueber Combination von Krebs und Tuberkulose.* Gottingen: Kastner.

RENTSCHLER, C. B., and TRAVIS, R. C. (1934), *J. Amer. med. Ass.*, **102**, 686.

RIZZI, I. (1934), *Pathologica*, **26**, 699.

SECHI, V. (1944), *Gior. clin. Med.*, **25**, 197.

SIMMONDS, M. (1900), *Munch. med. Wschr.*, **47**, 317.

SPRUNT, D. H. (1930), *Surg. Gynec. Obstet.*, **51**, 245.

SYMMERS, W. ST. C. (1951), *Amer. J. Path.*, **27**, 493.

TSUNEHISA, S. (1930), *Gann*, **24**, 1.

WHITE, R. R. (1943), *Proc. Mayo Clin.*, **18**, 165.

WOLF, R. (1929), *Z. Krebsforsch.*, **30**, 482.

THE NEGATIVE X-RAY REPORT IN CANCER OF THE COLON

BY GORDON S. RAMSAY

WESTMINSTER HOSPITAL TEACHING GROUP (THE GORDON)

THE purpose of this communication is to emphasize the fact that a negative X-ray report on a patient with cancer of the colon is likely to lead to delay in diagnosis and treatment.

There were 151 cases of carcinoma of the colon treated at the Gordon Hospital from 1947 to 1953, during which time 2325 barium enema radiographs were done. *Table I* shows the distribution of growths according to anatomical site.

Table I.—DISTRIBUTION OF COLONIC GROWTHS ACCORDING TO ANATOMICAL SITE

Site	*No. of Cases*	*Percentage*
Cæcum	17	11·3
Ascending	5	3·3
Transverse (inc. flexures)	12	8·0
Descending	8	5·3
Sigmoid	109	72·1
Total	151	

Of the 151 cases, 75 were radiographed and in 10 a negative report was given (3 of these were radiographed at other hospitals). *Table II* shows the number of cases radiographed and not radiographed according to anatomical site.

A delay occurred in making the diagnosis in 7 out of the 10 patients with negative X-ray reports, because it was thought that the radiograph had excluded the possibility of a growth.

Table II.—SITE DISTRIBUTION OF CASES ACCORDING TO WHETHER RADIOGRAPHED OR NOT

	Radiograph	*No Radiograph*
Cæcum	7	10
Ascending	5	—
Transverse (inc. flexures)	5	7
Descending	4	4
Sigmoid	54	55
Total	75	76

Short notes on the 10 patients are as follows:—

Case 1.—P. L., male, aged 65. Hæmorrhoidectomy, 1947. Slight 'bowel delay' in the mornings, 1950; barium enema, September, 1950, showed nothing abnormal. Patient seen again in March, 1952: occasional slight bleeding and loss of weight. A mass was felt through the anterior rectal wall. A second barium enema in March, 1952, was reported as normal. His symptoms continued, and a third barium enema was done in July. This showed a few diverticula but no evidence of a growth. The mass felt per rectum was

considered to be due to diverticulitis, and the patient was told to come back if he had any further trouble. He reported again on Sept. 23, 1953, and on examination the liver was found to be very hard; a hard mass was found in the rectum, and the patient was admitted. At laparotomy, on Oct. 1, free fluid was found in the peritoneal cavity, and the liver was full of metastases.

FIG. 692.—*Case* 3. Second barium enema radiograph done in October, 1953, showing filling defect in the sigmoid loop.

There was a large growth in the sigmoid colon. A palliative colostomy was performed and the patient died on Oct. 15. *Delay:* 3 *years.*

Case 2.—G. T., male, aged 41. Symptoms of abdominal pain and occasional bleeding per rectum for "years". Barium enema and barium meal and follow-through, done elsewhere in 1950, showed diverticulosis of the descending colon. On Feb. 28, 1952, patient was referred for treatment of piles. A polyp was found on sigmoidoscopy at 13 cm. and a barium enema showed a stricture just beyond the rectosigmoid. At laparotomy, on Mar. 17, multiple polyposis of the pelvic colon and rectum was found with two carcinomata in the sigmoid. *Delay:* 1½ *years.*

Case 3.—E. M., female, aged 53. Attended Oct. 11, 1953, complaining of urgency of defæcation, passing blood and mucus, and loss of weight for one year. A barium enema, done elsewhere in February, 1953, was normal. On examination a mass was felt in the left iliac fossa and per rectum. A barium enema on Oct. 16, 1953, showed a filling defect in the sigmoid (*Fig.* 692) and at laparotomy on Oct. 27 this was found to be due to a large carcinoma of the pelvic colon adherent to the wall of the pelvis. *Delay:* 8 *months.*

Case 4.—A. S., male, aged 53. Admitted June 23, 1951, with 11 months' history of diarrhœa, blood, and mucus, constipation and loss of weight. A barium enema, done elsewhere in Jan., 1951, was negative. On examination, a mass was felt per rectum, and at laparotomy on July 3, 1951, a carcinoma of the sigmoid was found. *Delay:* 6 *months.*

Case 5.—T. D., male, aged 59. Attended July 11, 1952. For one month patient had passed blood and mucus five to six times daily; he had had a left-sided abdominal pain, and tenesmus. Patient was asthmatic and had complete nasal obstruction due to polypi. A mass was felt through the rectal wall, and sigmoidoscopy

FIG. 693.—*Case* 5. Carcinoma of the pelvic colon. Normal barium enema radiograph.

to 23 cm. revealed a small amount of blood-stained fæces. A barium enema on July 23 was normal (*Fig.* 693). Sigmoidoscopy was then repeated and was normal to 25 cm. A barium meal and follow-through on Aug. 6, and a straight radiograph of the pelvis on Aug. 17, were both normal. The mass became impalpable and the patient was transferred to the E.N.T. Dept. for removal of his nasal polypi. He was re-admitted for further investigation, because his symptoms persisted, and at laparotomy on Oct. 10, a carcinoma of the pelvic colon was found adherent to the upper part of the rectum. *Delay:* 3 *months.*

Case 6.—M. J., female, aged 54. Attended Dec. 22, 1952, complaining of abdominal pain for two weeks and a recent change of bowel habit. There was tenderness in the right iliac fossa. Rectal examination was negative. A provisional diagnosis of appendicitis was made, and a barium meal and follow-through was done on Jan. 12, 1953, and reported on as follows: "A fairly complete outline of the colon showed no abnormality". Whilst awaiting admission for appendicectomy, the patient had an acute exacerbation of her abdominal pain and nausea. She was therefore admitted as an emergency on Feb. 21. The pain subsided with rest in bed, and a laparotomy was performed on March 3. A carcinoma of the pelvic colon was found, with infiltration of the mesentery which was causing bilateral ureteric obstruction. Multiple metastases were found in the liver. *Delay:* 2 *months.*

Case 7.—E. O., female, aged 71. Attended June 23, 1952, with three weeks' history of pain in the abdomen,

back, and chest, flatulence, slight loss of weight. Her bowels were open daily. The liver was enlarged and irregular, but rectal examination was negative. A barium meal and follow-through on June 30 was reported on as follows: "Filling of the colon is not complete, but there is no evidence of neoplasm of the colon". The patient was admitted on Aug. 9 suffering from jaundice. The liver was further enlarged and there was free fluid in the peritoneal cavity. The patient died

FIG. 694.—*Case* 9. Barium enema radiograph reported as normal but showing filling defect near apex of sigmoid loop.

shortly after admission. Autopsy revealed a large carcinoma of the rectosigmoid with massive deposits in the liver. *Delay: 2 months.*

Case 8.—A. R., male, aged 76. In September, 1945, a carcinoma of the sigmoid was resected elsewhere. Patient was admitted on June 7, 1951, for excision of a swelling at the upper end of the laparotomy incision. Bowel sounds were heard in the right axilla, and to exclude a right-sided diaphragmatic hernia, a barium meal and follow-through was done on June 18. This revealed marked elevation of the right side of the diaphragm, with the hepatic region of the colon above and anterior to the liver. At operation for excision of the mass, which proved to be a recurrence, the peritoneal cavity was opened and a carcinoma was found just below the hepatic flexure. *Delay: Nil.*

Case 9.—M. C., female, aged 48. Admitted June 13, 1948, complaining of prolapse of rectum. Sigmoidoscopy was normal to 22 cm. A barium enema on June 18 showed a very dilated and redundant colon, but apart from this it was reported on as normal. A filling defect showed on one of the films (*Fig.* 694) and the diagnosis of carcinoma was confirmed at laparotomy on June 25. *Delay: Nil.*

Case 10.—A. H., female, aged 47. Admitted on Jan. 24, 1948. For three years the patient had passed blood on occasions per rectum, and had recently developed diffuse abdominal pain; liquid stools and general weakness. A craggy mass was palpable in the left iliac fossa, but a barium enema on April 28 showed no abnormality. A carcinoma of the lower sigmoid was found at laparotomy on May 13. *Delay: Nil.*

DISCUSSION

There are few figures on record to show what degree of error is to be expected in the radiological diagnosis of carcinoma of the colon, but it appears to be less than 10 per cent. Thus, Trasoff and Goodman (1943) found 2 negative out of 49 barium enemata; and Brown and Colvert (1947), in a series of 50 cases of carcinoma of the cæcum, found a negative result in 4. Vynalek, Saylor, and Shrek (1947) say that 9 per cent of tumours of the sigmoid were missed by X-ray examination. In the present series a negative report was given in 9 out of the 54 cases of carcinoma of the sigmoid examined radiologically, i.e., 16·7 per cent.

After his investigation into the use of X-ray reports in the diagnosis of carcinoma of the colon, Haggie (1952) expressed the following opinion: "It seems that the barium enema, a most useful investigation in its place, is often used unnecessarily. This, I think, is because it is used to exclude rather than to confirm the diagnosis of carcinoma of the colon."

With these remarks I agree entirely. The diagnosis of cancer of the colon depends primarily upon the history and clinical examination, and it is quite wrong to assume that a negative radiograph can exclude the possibility of a growth. Yet, most of the 2325 barium enemata were done for this very purpose on patients with neither abnormal physical signs nor a typical history. It is not surprising, therefore, that delay in diagnosis occurs in such a high proportion of those few cases in which the growth does not show up on X-ray examination. Yet all but one (*Case* 7) of the 7 cases with delayed diagnosis had histories suggestive of a carcinoma of the colon, and in 2 a mass was felt.

The need to beware of accepting too readily a negative X-ray report has been stressed by several writers: Jones (1936), Brown and Colvert (1947), Renshaw (1939), Davis and Daniel (1947), Sheddon and Dresser (1940), and others. But, as is shown by the above cases, this lesson has still to be learnt, and we would do well to heed the words of Bockhus (1944), who urges us to "... studiously avoid a sense of false security given by negative reports following barium enema study, particularly where there are clinical indications of malignant disease of the colon". If, in spite of a negative radiograph, the history and clinical findings are suggestive of a carcinoma, then an exploratory laparotomy must be done without delay.

SUMMARY

Seventy-five of the 151 cases of carcinoma of the colon were examined radiologically; 10 of these had a negative report, and in 7 there was a delay for from two months to three years in making the diagnosis. It is urged, therefore, that in spite of a negative radiographic report an exploratory laparotomy should be done if the history and clinical findings are suggestive of a carcinoma.

My thanks are due to Mr. Stanley Aylett, at whose suggestion this investigation was undertaken; and also to the Department of Medical Photography, Westminster Hospital, for the photographs.

REFERENCES

BOCKHUS, H. L. (1944), *Gastroenterology*. Philadelphia: W. B. Saunders & Co.
BROWN, C. H., and COLVERT, J. R. (1947), *Ann. intern. Med.*, **27**, 936.
DAVIS, K. S., and DANIEL, W. H. (1947), *Radiology*, **49**, 50.
HAGGIE, M. (1952), *Lancet*, **1**, 21.
JONES, T. E. (1936), *Med. Clin. N. Amer.*, **78**, 1831.
RENSHAW, J. F. (1939), *Surg. Clin. N. Amer.*, **19**, 1121.
SHEDDON, W. M., and DRESSER, R. (1940), *Amer. J. Roentgenol.*, **43**, 715.
TRASOFF, A., and GOODMAN, D. H. (1943), *Amer. J. dig. Dis.*, **10**, 132.
VYNALEK, W. J., SAYLOR, L. L., and SHREK, R. (1947), *Surg. Gynec. Obstet.*, **84**, 669.

METASTASIZING INSULINOMA WITH HYPOGLYCÆMIA

BY R. CUNLIFFE SHAW, PRESTON

SINCE the recognition of spontaneous hyperinsulinism associated with tumours of the islets of Langerhans and the demonstration by Wilder, Pares, and Robertson (1927) of functioning islet-cell carcinoma of the pancreas, nearly 400 cases have been recorded, most of which proved to be adenomata and only about 29 were metastasizing insulinomas exhibiting hormonal activity. In Great Britain, as pointed out by Black, Corbett, Hesford, and Turner (1954) the number of islet-cell tumours that have been reported is comparatively small. Here the first successful removal of an adenoma was by Fraser, Macloy, and Mann (1938), and 12 further cases removed by operation have now been recorded in this country but only 1 case of functioning carcinoma (by Brearley and Laws, 1950). The latter in their paper on carcinoma of the islets of Langerhans with hypoglycæmia review 19 other cases recorded abroad. In making their selection they included only cases of carcinoma with metastases and indisputable hypoglycæmia, but mentioned a number in which metastases were present but hypoglycæmia was known to be absent. In their series only 2 cases survived over a year; one of these recorded by Browning (1943) was a male age 36 who had a malignant insulinoma involving the body and tail of the pancreas with liver and lymph node metastases. A biopsy on the latter was taken and the patient died fourteen months later. The duration of his symptoms was twenty months. The other case of Brunschwig, Allen, Owens, and Thornton (1944) was a male age 32, who had multiple primaries in the pancreas and secondary deposits in the liver. He had excision of two tumours in 1939, excision of a large tumour in the body and tail of the pancreas in 1940, and in 1942 excision of a mass in the head of the pancreas and metastases in the liver. In August, 1943, he was treated with alloxan and in December of the same year had a pancreaticoduodenectomy and a further excision of the liver metastases, but he died two hours after operation. The duration of his symptoms was fifty-four months.

In Whipple's personal series as given at the Banting Memorial lecture in 1951, 39 cases of insulinomas were recorded. Of these there were only four carcinomas, but 1 of them was non-functional. Two died post-operatively—one of pneumonia on the fourth day and the other of hepatic failure on the tenth day. The third case died four months after an exploratory laparotomy in another hospital.

Howard, Moss, and Rhoads (1950) also reviewed the insulinomas up to that date and collected 398 cases, of which 22 were functioning islet-cell carcinomas. Their series closely corresponds to that recorded by Brearley and Laws, but omits the latter's case and gives in addition the case of Marble and McKittrick (1946) which died two months after a partial resection of the tumour, Luft's (1947) case which died after operation for a biopsy of the liver; and the one reported by Sauchez, Ubeda, and Carr (1947) where there was no operation.

Eskelund (1953) recorded 2 further cases of his own. The first was a male aged 38 who had a resection of the body and tail of the pancreas for multiple tumours on Sept. 16, 1944. Hepatic metastases were present, but the patient survived fourteen months, during which period there was a temporary post-operative improvement, and after a further relapse a course of X-ray therapy produced a slight remission of symptoms. His second case, a male aged 40, had an apparently benign insulinoma resected from the head of the pancreas on May 20, 1939, and the hypoglycæmic attacks did not recur until seven and a half years later. At a further operation in 1947 tumours were resected from the body of the pancreas, but the patient died twenty-seven days later during a hypoglycæmic phase. Autopsy showed that the liver contained secondaries.

A further case reported by Nadal (1952) illustrates this feature of the insulinomas, when an apparently benign tumour was found years later to have metastasized. On Jan. 19, 1944, a biopsy of the pancreatic (egg-sized) tumour was reported as an "adenocarcinoma Grade IV". On Jan. 22, 1944, pancreaticoduodenectomy was carried out, but at this time the tumour was considered to be a "benign adenoma of the pancreas, islet-cell type". Six years later, Dec. 29, 1949, a further operation revealed many hepatic tumours all of which were islet-cell in origin. The patient was alive two years later (Dec., 1951). In this case the islet-cell growth was non-functioning.

The following case of an islet-cell carcinoma invading the proximal lymph-nodes and giving rise to spontaneous hyperinsulinism has survived partial pancreatectomy and splenectomy over two and a half years and is still in normal health. The

pre- and post-operative history of this patient presents features of special interest which may indicate a linkage between adrenosympathetic imbalance and the development of tumour hyperplasia culminating in malignant invasion.

CASE REPORT

HISTORY.—A male, aged 49, a motor mechanic, was referred to me in July, 1953, with a history of abdominal pain. He stated that ever since boyhood he had suffered from the increasing disability of sweating and faintness if he experienced either psychic or somatic trauma, and

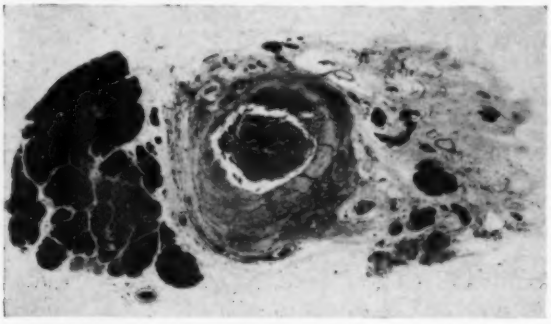


FIG. 695.—Section of the pancreas showing insulinoma in the centre and to the right: normal pancreas is seen on the left. H. and E. (× 6.)

as he grew older this reaction to injury or unpleasant news became a more prominent feature in his life, so that he was careful to avoid seeing anyone who was injured and conversation where such a subject was mentioned. During the war he had to work long hours in an engineering shop and noticed that he became very tired two or three hours after a meal. He experienced a slight degree of faintness but the symptoms always passed off if he had a sweet drink. On no occasion had he actually lost consciousness. The pain symptom commenced two to three years prior to this examination and was located over the epigastrium and to the right of the umbilicus. At first this only amounted to a slight discomfort, which was noticable on driving a car or sitting in a deep chair. After a few months the pain increased in intensity, and, although intermittent at first, gradually became continuous. It bore no clear relation to food and was principally experienced during the day time. There was very little discomfort after meals, but occasionally there was a sensation of tightness in the chest about an hour to an hour and a half after food. After a year the pain was referred to the lumbodorsal region and also below the left costal margin, and the patient found he obtained relief on change of posture. He had been treated by dietary, alkalis, and antispasmodics, and anti-acids without relief. There was no nausea or vomiting and constipation was chronic from boyhood. In the last few months there has been a definite loss of weight and anorexia, and he felt constantly tired and unable to cope with his normal occupation.

X-ray examination was carried out on July 15 and a barium meal showed a deformity of the duodenal cap but no ulcer crater was seen. The gastric emptying rate was within normal limits and the follow-through showed no abnormality. A barium enema showed no delay in the position of the enema and the colon presented a normal outline.

Shortly after this examination he had a major hypoglycæmic attack. He was feeling tired in the morning and generally weak and ate very little breakfast and hardly any lunch. He remained at home resting all day and had a light tea about 6 p.m. At 8.45 p.m., whilst sitting in a chair, the sensation of weakness and faintness rapidly increased. He thought he would get up and go to bed. He stood at the foot of the stairs and his wife who was looking at him noticed that he was sweating profusely, looked very pale, had a vacant look in his eyes, and was swaying from side to side. He slowly ascended the stairs but gradually sank to his hands and knees and finally struggled with help as far as the bedroom, where he lost consciousness. This lasted for a few minutes, during which time he was sweating profusely. He slowly regained consciousness and was helped to the lavatory, but there was no vomitus and no stool. There was pronounced palpitation and he remained slightly confused and in a weak condition for some minutes, when he was helped to bed and the attack gradually passed off after some hours of great prostration, improvement slowly following hot sweet drinks.

ON EXAMINATION (Aug. 3).—He was admitted to hospital immediately after this attack and presented a calm and collected account of his history. There was no tremor of the limbs, but he was quite evidently anxious about his condition. His speech was slow and deliberate and there was noticeable delay between question and answer. He stated that the pain had become severe, that he had no appetite, and was now rapidly losing weight. On examination the abdomen was soft and there was slight tenderness in the transpyloric plane towards the left costal margin, and here there was a vague thickening which could be detected on deep pressure. He was slightly tender over the appendix. There was no enlargement of liver or spleen. Pelvic examination was negative. Pulse was 90, blood-pressure 120/80, and the urine negative. In view of the rapid increase of the pain element and the hypoglycæmic attack, a laparotomy was carried out the day after admission.

AT OPERATION.—The abdomen was opened through a paramedian incision under general anæsthesia and a hard craggy tumour was found in the tail of the pancreas. This involved the vessels in the hilum and spleen. Stomach and large bowel were free from the tumour. The liver and spleen presented no abnormalities and the tissues behind the pancreas appeared to be free from the growth. The whole of the tail of the pancreas, together with the spleen and the great omentum, was mobilized and removed well beyond the margin of the tumour. The remainder of the pancreas appeared to be normal on palpation. The appendix was removed and the abdomen closed after a drain had been placed in the bed of the pancreas.

PATHOLOGY.—Dr. A. A. Miller reported on the tumour as follows: "The tail of the pancreas and some of the adjoining great omentum together with the spleen. The portion of pancreas measures 5 × 3 × 3 cm. and weighs 25 g.: it is firmer than normal, almost hard in consistency. Section reveals a lobulated tumour, replacing most of the pancreatic tissue: The lobules are round, white in colour, and firm in consistency. On the periphery of the tumour there are portions of normal pancreas (*Fig.* 695). On the proximal fat there are a few enlarged lymph-nodes which appear invaded. The spleen appears normal.

Histology.—The microscopical picture is that of an insulinoma: there are numerous small and large circumscribed tumour nodules replacing pancreatic tissue (*Fig.* 695); the structure is acinar and trabecular (*Figs.* 696, 697); large portions show solid acini (*Fig.* 698); in some areas islets of tumour are embedded in dense fibrous stroma (*Fig.* 699). The proximal lymph-nodes are widely invaded. This is probably a malignant insulinoma of the pancreas."

PROGRESS.—Recovery was uneventful and the pain syndrome immediately disappeared after operation. The patient's appetite rapidly improved and his weight increased. On Aug. 7 hæmoglobin was 97 per cent and W.B.C.s 13,200. Serum-amylase 160 units. A glucose-tolerance test on Aug. 18 gave a normal response, the

fasting blood-sugar was 80 mg. per 100 ml., and, after 50 g. of glucose, at ½ hour 140 ml., 1 hour 190 ml., 1½ hours 150 ml., 2 hours 110 ml. The urine contained no sugar in the early morning, 0·3 per cent at 1 hour, and ketones were absent.

FIG. 696.—Section of insulinoma showing acinar structure and solid cell areas. H. and E. (× 250.)

FIG. 697.—Section of insulinoma showing trabecular and acinar structure. H. and E. (× 100.)

The liver function tests on Oct. 1 were as follows :—

Van Den Bergh D.I.	=	Negative
Ind.	=	1·1 units
Thymol turbidity	=	8·4 ,,
Alcohol turbidity	=	4·2 ,,
Gamma globulin	=	13·2 ,,
Total lipids	=	21·2 ,,
Takata ara	=	Negative
Alkaline phosphatase	=	12·9 ,,

The increased thymol turbidity was most probably due to an increase of lipids and the latter was probably post prandial. The liver function therefore appeared normal.

It was most interesting to note that after operation, when the patient had been discharged home and was in his usual surroundings, he felt a distinct increase of confidence in that he no longer feared to hear of unpleasant events. He no longer experienced the sweating and faintness which invariably accompanied such news.

On Oct. 16 the blood-sugar was 114 mg. per 100 ml. A glucose-tolerance test showed a glycosuria of the ' lag ' type, and the graph a hypoglycæmia of the over-compensated type. Hæmoglobin 103 per cent, R.B.C.s 5·5 ml., C.I. 0·9., W.B.C.s 10,850.

RE-EXAMINATION (Aug. 7, 1954).—The patient now carries on his normal work and has regained his usual weight. He is completely free from pain and his appetite is up to his normal standard—that is to say he has never been a " great eater ", but he enjoys a variety of food and does not suffer from any dyspeptic symptoms apart from occasionally feeling slight distension after a full meal. The bowels are constipated as usual, but react to simple laxicants. He has experienced no further hypoglycæmic attacks and he is immune from psychological reaction on reference to or encounter with unpleasant subjects, particularly that of injury or death. His wife states that occasionally after a long day's work if he does any gardening or unusual domestic duties he constantly sweats, accompanied by blanching of the face and feels a fullness at the top of his head, but these symptoms promptly disappear on taking a sweet drink. There has been one incident of a psychological nature which might be linked with his previous condition. The occasion happened when he drove a car about 100 miles to see a sick relative in the Midlands. During the day he had had little food apart from drinks of tea and a sandwich and on leaving the hospital to return home he lost his way. It was getting dark. He was accompanied by his wife and he became agitated, stopped the car, and a passing motorist pulled up and asked if he could help because he thought the driver must have been feeling unwell in view of the way in which the car was driven. This phase of excitement was very transitory. It disappeared immediately he was shown the correct road, and after he had had a hot drink of sweet coffee he then drove 100 miles without further incident. It seems possible this might be linked with the previous pre-operative instability of the adrenosympathetic mechanism, but there is nothing to link it with hypoglycæmia, and the fasting blood-sugar has remained at normal levels. Following this examination the patient twice experienced a slight ' swimming ' sensation in the head, on one occasion after running and on the other after a long day's work and doing some domestic duties at home. Both these incidents were corrected by eating sweets and taking hot sweet drinks. It was therefore thought that early hypoglycæmic attacks were returning and he was admitted to hospital for further investigation on Sept. 14.

After twenty-four hours fasting the blood-sugar was still 88 and there were no symptoms of hypoglycæmia. The patient felt very well and had a hearty appetite for

a meal. A glucose-tolerance test of 50 g. showed a rise at ½ hour of 220, 1 hour 250, 1½ hours 220, 2 hours 200, 2½ hours 180; Ketones were absent. One per cent sugar was present at 1 hour and at ½ hours. Mr. E. B. Love's comments on the graph are as follows: "The peak is higher than previously. This may be the result of the prolonged fast. In previous curves the appearance of over-compensated hypoglycæmia was noted, but from curve to curve there has been a gradual delay in the onset of the hypoglycæmia and now this is entirely absent. The curve is more characteristic of a mild diabetic but the result might be due to the fast".

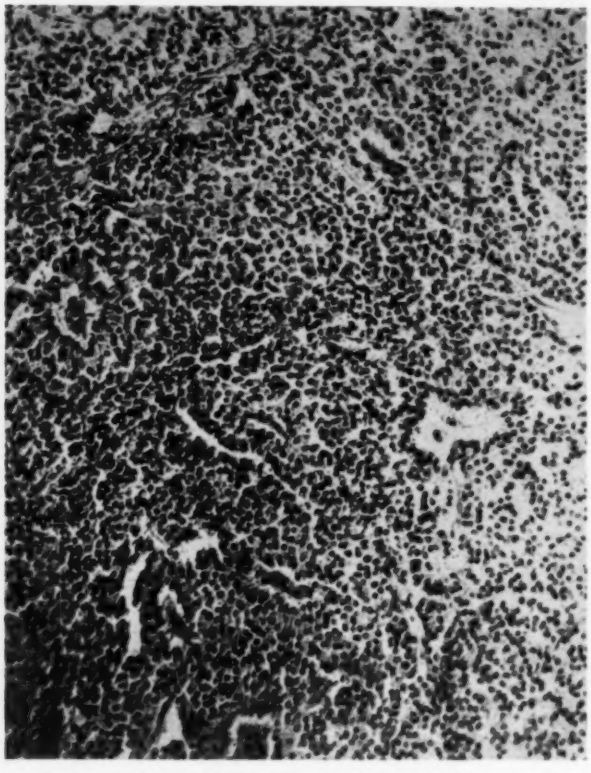


FIG. 698.—Section of insulinoma showing solid acini. H. and E. (× 250.)

The liver function test gave the following result:—

Van Den Bergh D.I.	= Negative
Ind.	= 3·6 units
Thymol turbidity	= 3·6 ,,
Alcohol turbidity	= 0·9 ,,
Takata ara	= Negative
Gamma globulin	= 9·6 ,,
Total lipids	= 10·6 ,,
Alkaline phosphatase	= 10·8 ,,
Hæmoglobin	= 98 per cent
R.B.C.s	= 4·9
C.I.	= 1·0

The adrenal cortex was directly stimulated by the intramuscular injection of 25 mg. of ACTH and the eosinophil count was taken before injection on a fast and after an interval of 4 hours. This showed a drop from 381 per c.mm. to 100 per c.mm. (normal 100–300 esinophils per c.mm.), showing a very marked activity of the suprarenals. Again adrenaline was injected spontaneously to test the activity of the anterior pituitary to secrete ACTH. On a fasting stomach 0·3 c.c. of 1–1000 adrenaline was injected spontaneously and the eosinophil count taken before and after the four-hour interval. This showed a drop from 120 to 94 per c. mm.

A radiograph of the skull, and particularly the pituitary fossa, and of the chest showed no radiological abnormalities.

DISCUSSION

It is evident from this man's history that excessive lability of the adrenosympathetic system has been present from youth, both psychic and somatic stimuli of an unpleasant or noxious character have from boyhood initiated an immediate adrenosympathetic syndrome—sweating, tachycardia, and peripheral vasoconstriction being followed by faintness. The occurrence of these attacks of weakness or actual faintness became more pronounced in recent years and suggest the possibility of intermittent spontaneous hypoglycæmia due to excessive islet-cell activity over a long period, as indicated by the relief he obtained from taking sweet drinks. One of Morley's cases (1952) always carried chocolates for this purpose.

FIG. 699.—Section shows nodules of insulinoma surrounded by dense fibrous tissue. H. and E. (× 100.)

A close linkage between the islet cells and the adrenosympathetic anterior pituitary mechanism in connexion with glycogenolysis suggests that when hypoglycæmia develops in the insulinomas adrenaline is secreted in amounts large enough to mobilize enough glycogen to increase the blood-sugar concentration and promote spontaneous recovery.

In our patient pain was an outstanding clinical feature which is certainly not common to the majority of islet-cell adenomas but is clearly diagnostic of the islet-cell carcinoma, particularly when metastases are present, whether functioning or non-functioning, as shown by one of Howard's cases. This symptom was again evident in the islet-cell carcinoma reported by Brearley and Laws (1950)

where mid-epigastric pain radiating to the left costal margin and the back, started in March, 1948, eighteen months before the patient's death. In Crain and Thorn's (1949) review of the insulinomas, abdominal pain was found to be present in 8 per cent of 193 patients. We must, therefore, suspect a malignant insulinoma in any case where the Whipple triad of fasting hypoglycæmia relieved by sugar is accompanied by persistent epigastric pain radiating to the back or left costal margin and unrelated to the ingestion of food and not relieved by alkalis or dietary.

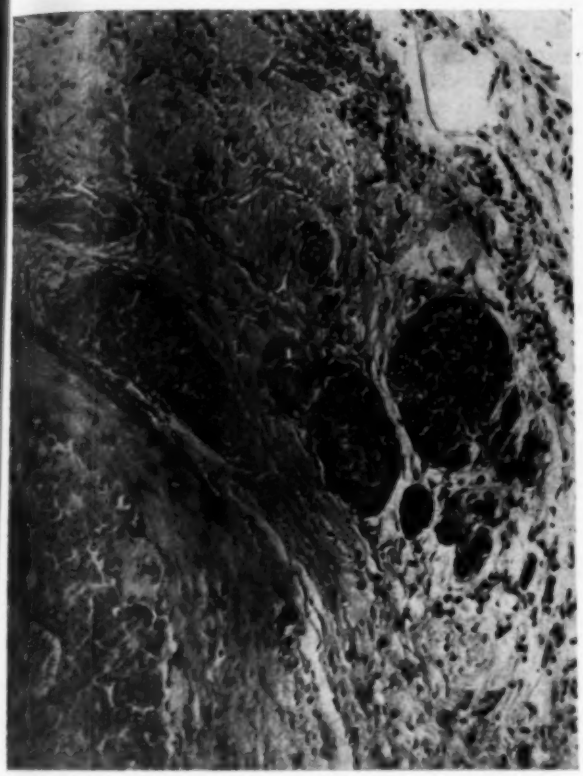


FIG. 700.—Section through a dense fibrous portion showing islets of tumour tissue. H. and E. (× 250.)

FIG. 701.—Section of a proximal lymph-node showing tumour invasion. H. and E. (× 100.)

In our case the urgency of operation was clearly apparent from the severity of pain combined with the loss of weight and anorexia, quite apart from the characteristic hypoglycæmic cerebral disturbance.

In previous research work I have shown that the abnormal stimulation of the adrenosympathetic apparatus lowers the pain threshold and experimental irritation of this mechanism produces tissue change in the vascular system as well as in ductless glands such as the thyroid. A series of experiments reported in 1926 showed that the vascular changes are constant and progress through a definite sequence, the earliest consisting in a proliferation of the intima in which both endothelial and elastic tissues participated, followed by hyperplasia of the elastic fibres in the media and early signs of degeneration in the smooth-muscle cells. Fat was deposited in the intima and the deeper layers underwent necrosis or hyaline change. These experimental changes have also been observed by Minouelian (1913), and Polettini (1920), Pearce (1926) and others, whilst similar changes to those initiated by chronic irritation of the sympathetic have been produced by adrenaline injection. Further investigation showed that irritation of the adrenosympathetic apparatus resulted in cell imbalance; extensive fibrosis and proliferation of epithelial cells was found in the affected tissue, and it was then suggested by the author (1933) that such tissue change was one of the factors preceding malignant invasion of the normal tissues by hyperplastic epithelial cells.

A review of the histology of those cases of insulinomas claimed as doubtfully malignant shows that in some of these the tumour cells formed syncytial masses in which there is only a slight tendency to acinar arrangement, and in some the cells had breached the fibrous capsule of the adenoma, but in none of these was there invasion of the lymph-nodes. Thus in Morley's 5 cases of insulinoma 3 exhibited these features, falling within the suspected malignant group. Again, 5 patients of Whipple (1952) came within this class; all were resected and remained well over periods ranging from six to thirteen years. The relatively slow growth of some of the insulinomas is shown by the cases of Brunschwig (1941), Eskelund (1953), Stuart Mason (1953), Nadal (1952), and Browning (1943). It seems probable that the suspected group of islet-cell adenomas are a stage towards those which are frankly malignant. In the case of the malignant insulinoma recorded by Morley which proved to be inoperable there was a very hard tumour in the tail of the pancreas invading the spleen and left kidney, and firmly adherent to the surrounding structures. In our own case the hard

consistency of the growth in the tail of the pancreas was particularly noticeable, and in one recorded by Howard and others (1950), there were areas of calcification within the tumour and the masses of islet cells were limited by a very thick fibrous capsule. Similar pathology was present in Eskelund's two cases. The close relationship between the adrenosympathetic mechanism and the islet-cell tumour is again suggested by the connective tissue changes. In a number of these adenomata degenerative changes have been found in the blood vessels within the tumour, whilst the cell masses are separated by a large amount of proliferating connective tissue, all of which changes could be produced by chronic irritation of the adrenosympathetic mechanism.

It would appear that marked proliferative and degenerative changes affecting connective tissues and blood-vessels, as well as the islet cells, are most pronounced in cases of proved carcinoma of the islets of Langerhans, or where there is histological evidence of syncytial formation of the islet cells and the invasion of the peri-islet tissues—tissue changes which have hitherto been grouped with the doubtfully malignant insulinomas.

Spontaneous hypo-insulinism linked with hyperfunction of normal islet nodes or with simple insulinomas does not appear to be associated with marked vascular and connective-tissue hyperplasia and degeneration. If these changes are present another stage in the history of the lesion has occurred, one in which the adrenosympathetic mechanism participates, as shown by the experimental irritation of the latter and the production of gradual and progressive proliferation and degenerative sequence in the cells both of the vascular tree and the supporting tissues. A further linkage with the adrenosympathetic system and the insulinomas may be through the overstimulation of the anterior pituitary by the intermittent and excessive secretion of adrenaline operating over prolonged periods. This may result in the excitation of an insulinotrophic or insulinogenic principle which directly stimulates the islet cells of the pancreas to abnormal activity.

It is therefore postulated that in the insulin tumour of the pancreas the earliest phase is one associated with adrenosympathetic instability, and this may last over years of a patient's life, the transitory hypoglycæmic attacks being rapidly corrected by mobilization of glycogen, but increasing stimulation of the anterior pituitary as well as the pancreas leads to the gradual onset of tissue-cell imbalance, in which not only the blood-vessels participate but also the islet cells and their supporting tissues leading to degeneration in the vascular supply of the tumour area, the production of dense fibrous tissue, and the syncytial formation of the islet cells. At this stage the tumour is one usually classed as doubtfully malignant. The continuation of the irritative factors soon leads to invasion of the pancreatic tissues and lymph-nodes in the neighbourhood of the tumour and the development of definite malignant characteristics. At a later stage the tumour cells invade the veins as well as the lymph-nodes and secondary functioning metastases appear in the liver. One outstanding peculiarity of the malignant insulinoma is the long period, in some cases extending over six or seven years, during which the body is able to maintain a barrier against the further extension of the growth, and even in cases where extensive secondaries have developed in the liver life is still prolonged for a period of a year or more. If the pain symptom in our case is a reliable criterion of the time of change from a simple insulinoma to that of a malignant tumour it seems probable that such a phase may easily extend well over two to three years. The change of character in the glucose tolerance graph from the over-compensated hypoglycæmic type to one of the sustained mild diabetic growth, suggests a radical change in pancreatic activity following the removal of the insulinoma, and possibly a rise in threshold of the anterior pituitary to adrenaline sensitivity.

It is interesting to compare the malignant insulinomas with the rare Hürthle-cell tumour of the thyroid probably derived from the water-clear cells of the parathyroid and the oxyphil cells. Similar to the insulinomas the metastases are selective (in this case bone, usually the skull) and functioning. They slowly destroy the surrounding tissue of the host, but life is prolonged, and although the secondary deposits show great local cell activity, as well as vascularity, widespread dissemination must be checked by a physiochemical tissue reaction comparable to that which inhibits the extension of the hepatic secondaries of the islet-cell tumours of the pancreas, and in consequence life may be prolonged over years.

CONCLUSIONS

1. Adenoma of the islet cells of the pancreas is a comparatively uncommon lesion, but those cases which show doubtfully malignant change constitute only 10 per cent of approximately 400 cases so far recorded, and of these only 5 per cent show definite evidence of metastases in the lymph-nodes and other tissues and can be definitely classified as functioning carcinomas of the islet cells.

2. In Great Britain 2 cases of proved carcinoma of the islet cells have been recorded, the one described by Brearley and Laws (1950) and the other the subject of this paper.

3. Most of the cases are only seen after major hypoglycæmic attacks have occurred, but it would appear that the condition may exist over many years without the latter being recognized, but associated with symptoms suggesting hyper-adrenalism which may spontaneously counteract the fall of blood-sugar by rapid glycogenolysis.

4. Pain is not a feature of the benign insulinomas, but appears in most cases of malignant change. It is persistent and tends to radiate to the left costal margin and to the back. The presence of Whipple's triad of fasting hypoglycæmic attacks relieved by the ingestion of sugar and the low fasting blood-sugar in addition to pain and anorexia is a strong indication that a malignant process is occurring in an islet-cell tumour of the pancreas.

5. It is suggested that the changes resulting in cell imbalance are directly linked with dysfunction of the adrenosympathetic anterior pituitary mechanism which causes proliferation of the islet cells and connective-tissue elements and results in cell imbalance and the invasion of the pseudo-capsule of the adenoma and the transition to a carcinoma.

6. These malignant changes are also accompanied by a proliferation and degeneration of the cells of the blood-vessels in the tumour area, as well as in the cells of the supporting tissues, resulting in dense fibrosis and hyalinization in the affected area.

7. If the condition is diagnosed at an early stage, probably the best procedure is a wide resection where the lesion is localized but where the primary tumours are multiple, or widespread radiation therapy may be tried as indicated by the case reported by Graham and Oakley (1950). The question of bilateral adrenalectomy is under consideration.

I must express my sincere acknowledgements to Dr. A. A. Miller and Mr. E. B. Love for their help and interest in the pathology and biochemical aspects of this case and for the photomicrographs; also for the comments of Dr. B. F. Brearley, whose previous experience of a similar case has proved most helpful.

REFERENCES

BLACK, K. O., CORBETT, R. S., HESFORD, J. P., and TURNER, J. W. ADREN (1954), *Brit. med. J.*, **1**, 55.
BREARLY, B. F., and LAWS, J. W. (1950), *Ibid.*, **1**, 982.
BROWNING, J. S. (1943), *Ann. intern. Med.*, **19**, 669.
BRUNSCHWIG, A. (1941), *Surgery*, **9**, 554.
— — ALLEN, J. G., OWENS, F. M. jun., and THORNTON, T. F. jun. (1944), *J. Amer. med. Ass.*, **124**, 212.
CRAIN, E. L., and THORN, G. W. (1949), *Medicine, Baltimore*, **28**, 427.
ESKELUND, V. (1953), *Acta path. microbiol. scand.*, **33**, 113.
FRASER, R., MACLOY, W. S., and MANN, S. A. (1938), *Quart. J. Med.*, **7**, 115.
GRAHAM, G., and OAKLEY, W. (1950), *Quart. J. Med.*, N.S. **73**, 21.
HOWARD, J. M., MOSS, N. H., and RHOADS, J. E. (1950), *Int. Abst. Surg.*, **90**, 417.
MANOUELIAN, Y. (1913), *Ann. Inst. Pasteur*, **27**, 12.
MASON, A. STUART (1953), *Proc. R. Soc. Med.*, **46**, 305.
MORLEY, J. (1952), *Brit. J. Surg.*, **10**, 98.
NADAL, J. W. (1952), *Ann. Surg.*, **136**, 313.
PEARCE, R. M. (1906), *Bull. Johns Hopk. Hosp.*, **17**, 94.
POLETTINI, D. B. (1920), *Arch. Sci. med.*, **43**, 63.
RICHARDSON, J. E., and RUSSELL, D. (1952), *Lancet*, **2**, 1054.
SHAW, CUNLIFFE R. (1922), *Brit. J. Surg.*, **9**, 450.
— — (1924), *J. Physiol.*, **58**, 288.
— — (1926), *Quart. J. Med.*, **19**, 203.
— — (1933), *Arch. Surg., Chicago*, **27**, 1072.
— — (1933), "Tissue Change and Sympathectomy." Thesis, Manchester.
— — (1935), *Med. Pr.*, **190**, 1.
— — (1946), *Arch. Surg., Chicago*, **40**, 646.
— — (1951), *Brit. J. Surg.*, **39**, 25.
WHIPPLE, A. O. (1952), *Canad. med. Ass. J.*, **66**, 334.
WILDER, PARES, and ROBERTSON (1927), *J. Amer. med. Ass.*, **89**, 348.

CHEMODECTOMA OF AN AORTIC BODY

BY D. A. GILLIS, D. P. REYNOLDS, AND J. W. MERRITT
THE INSTITUTE OF PATHOLOGY OF DALHOUSIE UNIVERSITY AND THE CHILDREN'S HOSPITAL, HALIFAX, NOVA SCOTIA

TUMOURS of the carotid body are well recognized. A number of organs similar to the carotid body have been charted. In addition to the glomus jugulare associated with the jugular bulb, and the groups of cells associated with the ganglion nodosum of the vagus, there are an indeterminate number associated with the vagi in relation to the arch of the aorta—the aortic bodies. All of these give rise to a singular tumour, the non-chromaffin paraganglioma or, more euphoniously, the chemodectoma, an apt term since, on the basis of morphology, the function of the aortic body was first brilliantly suggested to be a chemoreceptor one by DeCastro (1926; 1927). The chemodectomas are the subject of a monograph by LeCompte (1951), while Lattes (1950) has made the main contribution to aortic body tumours. As a general class the tumours are peritheliomate and, since a similar tumour has been identified in the thigh (Randall and Walter, 1954), chemoreceptor organs are probably of wider distribution. There are increasing reports of tumours of the glomus jugulare presenting as destructive lesions in the region of the middle ear (Gaffney, 1953). Tumours arising in the ganglion nodosum of the vagus are also recorded (Stout, 1935; Kipkie, 1947; and Lattes, 1950). Six tumours of the aortic bodies in man (Lattes, 1950; Monro, 1950; Duncan and McDonald, 1951; and McDonald, Aufderheide, and Fuller, 1954) and seven in dogs (Bloom, 1943; Mulligan, 1950) are reported in the English literature.

The chemodectomas, as with all tumour entities, have variation in structure, sometimes within a growth, and also from growth to growth. Characteristically they have a fine fibrovascular or highly vascularized reticulin stroma dividing the tumour

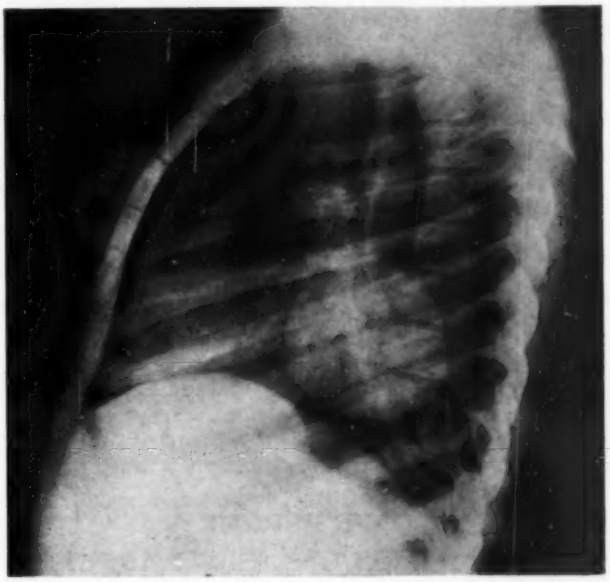


FIG. 702.—Radiograph (lateral) showing circumscribed tumour.

into regular baskets. The baskets are filled with cells either closely resembling the normal carotid body, or varying to distinctly epithelioid type or to a more compressed spindle-type cell. The nuclei are uniform and set in abundant finely granular or vacuolated cytoplasm with no distinct cell boundaries. More varied architecture can usually be discerned as a function of compression, though there may be areas with pleomorphism of nuclei and cytoplasm. Mitotic figures are rare or absent. The growths are circumscribed and encapsulated. Exceptionally they are locally malignant; a minority have metastasized, presumably by the blood-stream, to lungs, bone, and liver (Pendergrass and Kirsh, 1947; Randall and Walter, 1954). Aberrant function is not clinically manifest.

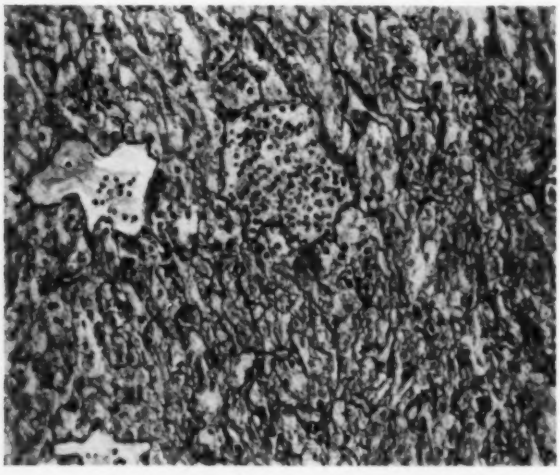


FIG. 703.—Reticulin preparation showing the regular basket-work. (× 144.)

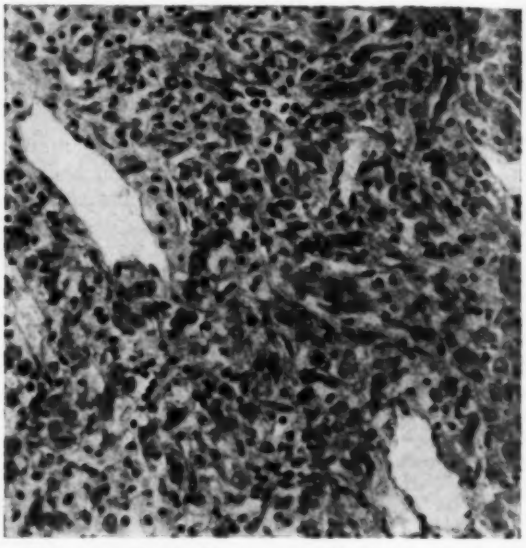


FIG. 704.—Showing the most regular pattern found: the capillaries are collapsed but the linear pattern of endothelial nuclei can be made out. (× 160.)

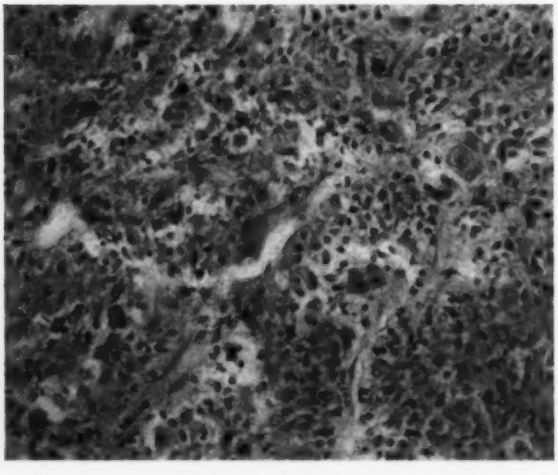


FIG. 705.—A more pleomorphic pattern than in *Fig.* 704.

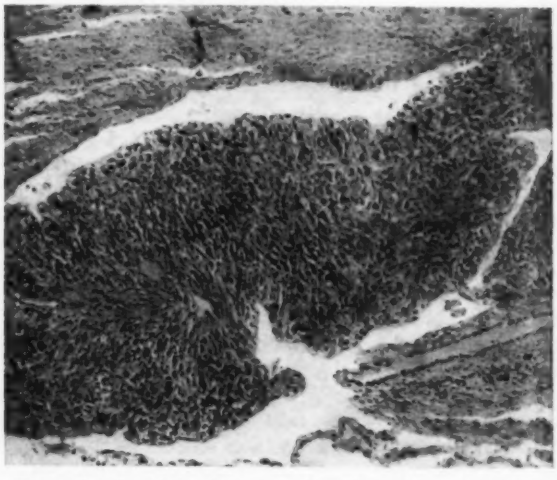


FIG. 706.—A nodule of tumour passes from the capsule into a subpleural lymphatic. The lung is below. (× 60.)

It is our purpose to record a primary tumour of an aortic body which was malignant and proved radio-resistant.

CASE REPORT

HISTORY.—M. M., a 7-year-old boy was admitted to the Children's Hospital in Halifax, Nova Scotia, on Dec. 1, 1951, because of anorexia, fever, loss of weight, and malaise of approximately one month's duration. Past history and family history were not unusual.

ON EXAMINATION.—The child was pale and thin. The only positive physical finding was bilateral inguinal lymphadenopathy.

Investigations: Hæmoglobin 8·3 g. per cent, W.B.C. 12,550 per c.mm., with 3 per cent band, 52 per cent polymorphs, 43 per cent lymphocytes, 1 per cent monocytes, 1 per cent eosinophils. Sedimentation rate 5 mm. (normal 0–9 mm.) in 1 hour. Urinalysis—negative. Kahn and Patch tests—negative. A chest radiograph revealed a circumscribed density in the right lower lobe (*Fig.* 702).

AT OPERATION.—A right thoracotomy was carried out on Dec. 13. A small orange-sized tumour was found on the anterolateral aspect of the right lower lobe. The surface of the tumour was bluish-red in colour and numerous dilated vessels coursed over it. There was no evidence of tumour elsewhere. A right lower lobectomy was performed.

PROGRESS.—The post-operative course was uneventful and the boy was discharged on Dec. 23. For two years

he had no further symptoms. In December, 1953, a small lump appeared in the skin at the site of the previous operation. This increased steadily in size until, at the end of two weeks, it was approximately the size of a golf ball. The tumour was very vascular but it was possible to remove it extrapleurally. Two months later he returned with an even larger recurrence of the tumour in the same area. A needle biopsy was performed. The tumour was fixed to the underlying tissues of the chest wall and was considered inoperable. By this time his general condition had deteriorated considerably. There was a high remittent fever which could not be explained on the basis of infection. This has not been reported in other cases. He also had anorexia and a moderate degree of anæmia. He received X-ray therapy with little apparent benefit. He was sent to London, Ontario, for treatment with the cobalt bomb, but the tumour did not respond and he was sent home. He died at home a short time later and no autopsy was obtained.

PATHOLOGY.—

Gross Pathology.—The original tumour, 4 cm. in diameter, was almost spherical and soft in consistency. It had a very thin capsule and was attached by flimsy adhesions to the pleura. The cut surface was moist and of a uniform greyish-yellow colour. The large veins, seen at operation running over the capsule, were collapsed and inconspicuous. There were no enlarged peribronchial nodes.

Microscopical Examination.—Reticulin stains showed the tumour to have a regular basket pattern (*Fig.* 703). The tumour was richly vascularized: large thin-walled vessels coursed through it and were clearly separated from the tumour tissue (*Fig.* 703); in addition the stroma was richly vascularized by capillaries, though the majority were collapsed. The cells filling the baskets varied from a uniform pattern of large finely granular cells with vesicular nuclei (*Fig.* 704) to a more pleomorphic pattern in which there was a mixture of clear cells with small dense nuclei and large finely granular cells (*Fig.* 705). The capsule was thin and discrete, but at the level of the lung adhesions subpleural lymphatics were filled with growth (*Fig.* 706). The original recurrence consisted of nodules of tissue similar to *Fig.* 705 set in the integument of the chest wall. Our diagnosis was confirmed by the panel of the Canadian Tumour Registry.

DISCUSSION

Lattes (1950) records 2 tumours in the thorax. In one case a male of 59 had a mass in the neck for fourteen years. The mass extended beneath the clavicle to the anterior mediastinum. He concluded that it had arisen from an aortic body. It was inoperable. The second case was in a male of 35 who died from bulbar poliomyelitis. From the autopsy findings it was concluded that he had three independent tumours involving the ganglion nodosum, the carotid body, and the adventitia of the aortic arch. Duncan and McDonald (1951) record the removal of solitary mediastinal chemodectomas from 2 patients. One died with what may have been spinal metastases. Monro (1950) records a case of mediastinal tumour with metastases in supraclavicular lymph-nodes. The illustrations are of a perithelioma, but it is questionable whether it belongs to this group. The recording by McDonald and others (1954) is not well substantiated by the illustration.

Most carotid-body-like tumours have been treated successfully by surgery and those irradiated have proved resistant, which distinguishes them from the endotheliomata for which they could be mistaken. While the series is small the behaviour of the aortic body tumours is similar to the group in that most are histologically simple but are surgical problems in regard to extirpation. While our tumour proved to be malignant, some chemodectomas with similar appearances, including invasion of veins (LeCompte, 1951), have been cured surgically. The primary tumour in our case was difficult to handle owing to its soft consistency, and the recurrence in the chest wall was probably an implant, but once the latter became manifest it grew rapidly and behaved as a locally malignant neoplasm. There was never any evidence of distant metastases.

In the differential diagnosis of such circumscribed tumours one would include neurilemmoma, ganglioneuroma, hamartoma, and, in the anterior mediastinum, thymoma and teratoma. It is possible that cases in the past have been mistaken for ganglioneuroma or thymoma which they may superficially resemble.

SUMMARY

Attention is drawn to the distribution of bodies similar to the carotid body and which can give rise to tumours (chemodectomas) in the region of the middle ear, in the upper cervical region, in the thorax, and also farther afield. The tumours are circumscribed and encapsulated, but a few are locally malignant or metastasize. They are radio-resistant.

A case is described of a chemodectoma in a boy of 7 years presumed to have arisen in an aortic body and which gave rise to a circumscribed intrathoracic tumour. He died from local recurrence of the growth, which showed increased rate of growth with each recurrence.

We gratefully acknowledge the kind assistance of Professor N. G. B. McLetchie.

Addendum.—The *Journal of Pathology and Bacteriology* (1954, **68**, 247) contains a report by Davies and Randall of a benign aortic body tumour in a woman of 67.

REFERENCES

BLOOM, F. (1943), *Arch. Path.* (*Lab. Med.*), **36**, 1.
DECASTRO, F. (1926), *Trav. Lab. Invest. biol. Univ. Madr.*, **24**, 365.
— — (1927), *Ibid.*, **25**, 331.
DUNCAN, D. K., and MCDONALD, J. R. (1951), *Amer. J. clin. Path.*, **21**, 515.
GAFFNEY, J. C. (1953), *J. Path. Bact.*, **66**, 157.
KIPKIE, G. F. (1947), *Arch. Path.* (*Lab. Med.*), **44**, 113.
LATTES, R. (1950), *Cancer*, **3**, 667.
LECOMPTE, P. M. (1951), *Tumors of the Carotid Body and Related Structures.* Washington: Armed Forces Institute of Pathology.
MCDONALD, O. G., AUFDERHEIDE, A. C., and FULLER, J. (1954), *Ann. Surg.*, **140**, 254.
MONRO, R. S. (1950), *Brit. J. Surg.*, **38**, 105.
MULLIGAN, R. M. (1950), *Amer. J. Path.*, **26**, 680.
PENDERGRASS, E. P., and KIRSH, D. (1947), *Amer. J. Roentgenol.*, **57**, 417.
RANDALL, K. J., and WALTER, J. B. (1954), *J. Path. Bact.*, **67**, 69.
STOUT, A. P. (1935), *Amer. J. Cancer*, **25**, 1.

ACUTE VOLVULUS OF THE STOMACH

By H. M. GOLDBERG and VERNON H. SMITH, Manchester

In most surgical textbooks acute volvulus of the stomach is discussed together with chronic or recurrent volvulus. This results in an insufficient stress being laid on the urgency of surgical treatment for the acute variety. Most papers dealing with acute volvulus have been inspired by post-mortem findings.

The first mention of volvulus of the stomach was by Berti in 1866. John Berg reported the first case successfully operated on in 1897. Buchanan reported a fatal case and reviewed 33 others from the literature in 1930. Cases have been reported in British

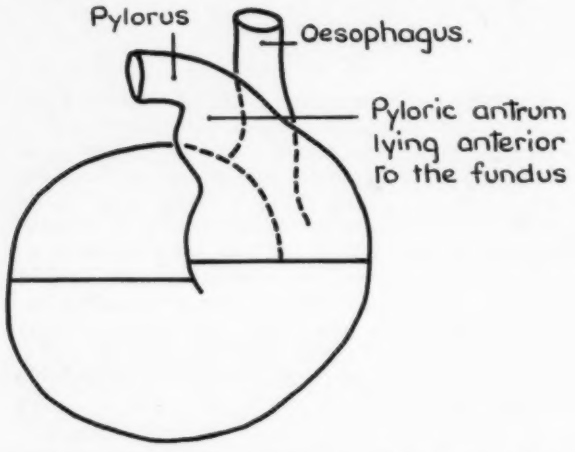


Fig. 707.—Diagram showing mesenterio-axial rotation of the stomach.

literature by Gharpure (1939), Osman Hill and Milroy Paul (1939), and Kidd (2) (1948). In 1952 Dalgaard added a post-mortem case and reviewed the literature collecting 155 cases.

From the available information it seems probable that only about one third of the recorded cases were actually acute surgical emergencies. Of these 48 cases collected from the literature the overall mortality was 60 per cent. For cases treated by conservative means the mortality was almost 100 per cent; whereas for those treated by operation the mortality was 45 per cent.

The clinical picture of the condition is characteristic. If the condition is kept in mind an early diagnosis should be possible. With timely surgical intervention a low mortality-rate can be expected.

CASE REPORT

D. E., aged 1 year and 10 months, was admitted to Booth Hall Hospital on Nov. 1, 1953, with a diagnosis of gastro-enteritis. The illness began 48 hours previously with diarrhœa which lasted for 24 hours. Next day he began to be sick and was still vomiting frequently on admission. Soon afterwards this changed to constant and ineffectual retching.

Although the child was rehydrated by intravenous therapy, his general condition deteriorated. No fluid was aspirated from an indwelling Ryle's tube.

He was seen by us on Nov. 2, obviously very ill with a rapid and thready pulse and cold, moist skin. There was visible distension in the left hypochondrium. A tense mass with a rounded lower margin could be felt in that region. It could be pushed under the left costal margin. The upper limits of the mass could not be felt. The rest of the abdomen was soft. Bowel sounds were

Fig. 708.—Pre-operative straight radiograph of the abdomen, showing typical fluid levels.

absent. The rectum was empty. There was no blood or mucus on the examining finger.

A diagnosis of high intestinal obstruction was made.

Pre-operative radiography of the abdomen showed marked eventration of the left cupola of the diaphragm and two fluid levels in the left hypochondrium (*Figs.* 707, 708).

At Operation (H. M. G.).—Right upper paramedian rectus slide incision. The small intestine was found to be collapsed. On tracing round the large intestine the transverse colon was found to disappear behind a greatly ballooned viscus. This, on close examination, proved to be the stomach. It was distended to the capacity of roughly one pint and showed mesenterio-axial volvulus with the pylorus situated anteriorly (i.e., rotated clockwise from below). The distended greater curvature had ruptured the gastrocolic ligament. This accounted for the transverse colon still lying behind the stomach. The gastrophrenic, gastrosplenic, and gastrohepatic ligaments were extremely lax and much longer than usual. The first three parts of the duodenum were completely mobile. De-torsion was performed and the pyloric region was sutured to the right upper posterior abdominal wall, in what was gauged to be its normal position.

It was significant that the child's condition improved as soon as the torsion was relieved. The anæsthetist was

then able to pass a stomach tube and draw off the excessive gastric contents.

POST-OPERATIVE COURSE.—Intravenous saline and gastric aspiration by Ryle's tube was instituted. The patient made a rapid recovery.

Check radiographs taken on Nov. 17, showed persistent eventration of the left cupola of the diaphragm. The stomach was some distance below the diaphragm, the pylorus and duodenal cap being at a slightly lower position than normal. Several coils of jejunum and the splenic flexure were interposed between the fundus of the stomach and diaphragm. (*Figs.* 709, 710.)

FIG. 709.—Post-operative barium meal, showing eventration of the left cupola of the diaphragm with small intestine interposed between diaphragm and stomach.

FIG. 710.—Post-operative barium meal showing high position of the splenic flexure of the colon.

DISCUSSION

Volvulus of the stomach can occur in acute and chronic forms. It can occur at any age in roughly even distribution, and is equally common in either sex.

Volvulus of the stomach occurs in two anatomical types. The axis of rotation lies either lengthways along the stomach from the cardia to the pylorus—the so-called organo-axial type (von Kocher, 1914); or at right angles to this—the mesenterio-axial type. Both occur with equal frequency.

For volvulus to occur the ligaments of the stomach must be much laxer than normal. This abnormality may be present for no obvious reason and is then presumably congenital in origin. However, the ligaments may have been stretched by some lesion in the stomach or diaphragm. Gastric lesions associated with volvulus are: Hour-glass stomach (first reported by Mazotti in 1874); An uncomplicated ulcer (Dini, 1879); A benign (Kaufmann, 1887) or malignant neoplasm (Frostberg, 1943). Diaphragmatic hernia, rupture or relaxation (eventration) of the diaphragm, is the commonest single factor associated with volvulus. In 1909 Peyer found volvulus or torsion of the stomach in slightly over 2 per cent of diaphragmatic herniæ.

The cases described in young children have mostly been in association with diaphragmatic hernia.

Once volvulus is anatomically possible, anything causing hypermotility of the stomach may act as the precipitating cause. Such may be a large meal (Buchanan, 1930; Berg, 1897; Lardennois, 1939; Morrison, 1931; and Pendl, 1904); trauma (Borchardt, 1904); or ingestion of large quantities of sodium bicarbonate (Breitkopf, 1927). It may occur during delivery (Bonsdorff, 1909) and during sudden physical exertion (Cardon, Greenebaum, and Arendt, 1947). In the last case the patient was lifting a piano.

Our case, we feel, was precipitated by gastro-enteritis.

Muhlfelder (1911) has demonstrated that vomiting often causes minor rotation of the stomach.

In diagnosis Borchardt (1904) emphasized the triad of acute meteorism, unsuccessful attempts at vomiting, and failure to pass a stomach tube.

The diagnosis rests on the following points:—

1. Epigastric pain, either intermittent or constant, but often of sudden onset.
2. Constant ineffectual retching associated with deterioration of the patient's general condition.
3. The palpation of a tense mass in the left hypochondrium.
4. The failure to pass a Ryle's tube.
5. The X-ray findings. Straight radiography of the abdomen is almost diagnostic by itself. There

are two (sometimes only one) fluid levels in the left hypochondrium. There are no other gas shadows in the abdomen. The fluid levels represent the stomach twisted upon itself, as shown in the diagram (*Fig.* 707).

This is the clinical picture of acute volvulus of the stomach which requires urgent surgical intervention. In chronic volvulus the stomach is only partially or intermittently shut off from the rest of the alimentary canal. It is a much commoner and less serious condition for which conservative measures will often suffice. It is often discovered accidentally on radiological examination.

In our case the significance of the failure to aspirate fluid by the Ryle's tube was not appreciated. It was assumed that the tube had become blocked by a plug of mucus, or that it was not in the stomach, owing to the understandable lack of co-operation by the patient, or that the tube was in the stomach which was empty.

As the child's condition was deteriorating operation was not delayed. If necessary a stomach tube was to be passed under the anæsthetic.

A marked feature was the deterioration in the child's condition in spite of its apparent hydration. This was due to the increasing pressure by the distended viscus in the left hypochondrium.

The pre-operative straight X ray of the abdomen (*Fig.* 708) was diagnostic.

We feel that the underlying cause of the great laxity of the gastric ligaments was the persistent eventration of the left cupola of the diaphragm. The precipitating cause of the volvulus itself was probably a mild attack of gastro-enteritis. It is probable that the volvulus actually took place while the child was in hospital.

TREATMENT

Treatment.—Cardon and others (1947) state that acute volvulus of the stomach can be treated by conservative means, but both their cases were acute flare-ups superimposed on a state of chronic torsion. Furthermore, one case is admitted to be unproven and the other case vomited continuously, with no retching, showing that the œsophagus was never completely occluded.

We feel that although conservative treatment may be successful in an occasional case, operation holds out the only hope of cure. It should not be delayed by time-consuming efforts at conservative treatment.

In acute volvulus of the stomach both the pylorus and œsophagus are completely occluded. The patient is the victim of a vicious circle. Gastric secretion is unable to escape, the stomach becomes distended, the distension stimulates further secretion, until finally ischæmia and strangulation supervene. The patient becomes more and more shocked in spite of efficient sedation and intravenous fluid therapy. When the stomach finally perforates a fatal termination is often near. This vicious circle can only be broken by operation.

At operation it may be necessary to aspirate fluid and flatus from the stomach in order to effect reduction of the torsion. If there is actual strangulation of the viscus either oversewing of the devitalized area or gastrectomy may be necessary and will carry with it an increased mortality. In cases where reduction of the torsion is all that is required, the condition of the patient improves as soon as this is performed.

The measures taken to fix the stomach in its correct position must vary from case to case, depending on the cause.

SUMMARY

A case of acute volvulus of the stomach successfully reduced by operation is reported, A description of the clinical picture, the aetiology, the diagnosis, and the treatment of the condition are given.

We wish to thank Miss J. Perry for the diagram.

REFERENCES

BERG, J. (1897), *Nord. med. Ark.*, 30/19, 1.
BERTI (1866), *Gazz. Med. Ital. Prov. Veneti*, **9**, 139.
BONSDORFF, H. (1909), *Finska, Läk. Sällsk. Handl.*, **51**, 287.
BORCHARDT, M. (1904), *Arch. klin. Chir.*, **74**, 243.
BREITKOPF, E. (1927), *Zbl. Chir.*, **54**, 1376.
BUCHANAN, J. (1930), *Brit. J. Surg.*, **18**, 99.
CARDON, L., GREENEBAUM, R. S., and ARENDT, J. (1947), *Ann. intern. Med.*, **27**, 455.
DALGAARD, J. B. (1952), *Acta chir. scand.*, **103**, 131.
DINI (1879), *L'Imparziale*, quoted by PEYER (1909).
FROSTBERG, N. (1943), *Acta radiol. Stockh.*, **24**, 217.
GHARPURE, K. C. (1939), *Brit. J. Surg.*, **26**, 630.
HILL, W. C. OSMAN, and PAUL, MILROY (1939), *Ibid.*, **26**, 632.
KAUFMANN (1887), quoted by DALGAARD (1952).
KIDD, H. A. (1948), *Ibid.*, **36**, 58.
VON KOCHER, T. (1914), *Dtsch. Z. Chir.*, **127**, 591.
LARDENNOIS, G. (1939), discussion to IMBERT and ESCARRAS, quoted by DALGAARD (1952).
MAZOTTI (1874), *Riv. clin. Bologna*, **4**, 280.
MORRISON, W. A. (1931), *Surg. Gynec. Obstet.*, **52**, 871.
MUHLFELDER, S. (1911), *Arch. Verdau.*, **17**, 53.
PEYER, A. (1909), *Mitt. a. d. Grenzgeb. d. Med. Chir.*, **20**, 686.
PENDL, F. (1904), *Wien. klin. Wschr.*, **17**, 476.

GANGRENE OF VENOUS ORIGIN

By R. F. MOORE and G. B. D. SCOTT

FROM THE SURGICAL UNIT AND DEPARTMENT OF MORBID ANATOMY, ST. MARY'S HOSPITAL, LONDON

It was recognized in the sixteenth century that gangrene of an extremity could be caused by venous thrombosis. However, it was not until the late nineteenth century that the clinico-pathological criteria were established (Heuter, 1859; Cruveilhier, 1862). In recent years a number of cases have been reported, but in some instances the diagnosis is doubtful and in most the pathological findings are absent.

Because of the relative rarity of this condition the following case is presented.

CASE REPORT

Mrs. D. H., aged 47, had a 'pancreatic cyst' drained on March 11, 1953. Following this she had an uncomplicated convalescence and was well until Aug. 25, 1954, when she was treated at home for left chest pain, dyspnœa, productive cough, and malaise.

FIG. 711.—Gangrenous right foot with subcuticular blebs and sloughing of the cuticle.

On Oct. 6 she noted the sudden onset of 'pins and needles' in her right foot. The next day her right thigh became very œdematous and she complained of severe pain in Scarpa's triangle, and in the right thigh and calf muscles. On the following day the lower leg and foot also became œdematous and the calf muscles indurated. A diagnosis of thrombosis of femoral and iliac veins was made and she was treated with bed rest, elevation of the right leg, and anticoagulants. Her condition remained unchanged until Oct. 11 when there was a sudden increase in the œdema, pain, and tenderness, and the tips of the second and fourth toes became cyanosed. She was transferred to St. Mary's Hospital, London, on the same day.

On Examination.—The patient was acutely ill and in great pain. Temperature 100° F., pulse 120. Apart from sinus tachycardia, the heart and lungs were normal. The liver edge was palpable three fingerbreadths below the right costal margin. In its centre was a non-tender egg-sized nodule. The left leg was normal.

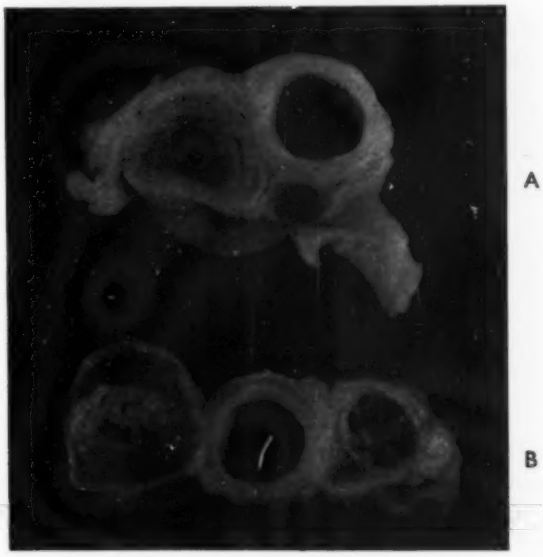


FIG. 712.—A, Popliteal vein occluded by pale thrombus. B, Posterior tibial vein (left) occluded by dark thrombus; anterior tibial vein (right) occluded by honeycombed tissue and dark thrombus. (× ⅔.)

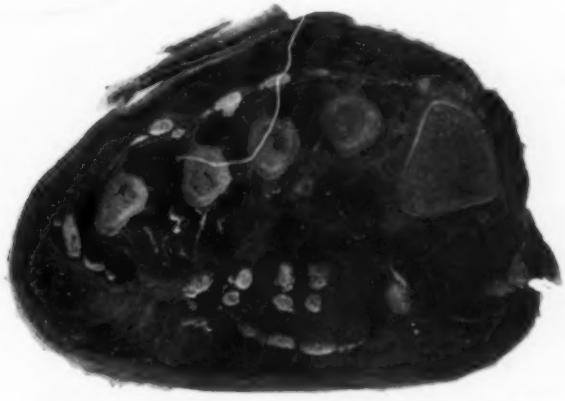


FIG. 713.—Coronal section of right foot through metatarsal bones, showing extensive thrombosis of superficial and deep veins. (× ⅔.)

The entire right leg and foot were painful and œdematous and the skin was shiny throughout. The thigh and upper third of the lower leg were normal in colour. Below this there was a faint cyanosis which became progressively duskier over the foot and toes. The second and fourth toes were deeply cyanosed and their tips were

black and cool; the cyanosis persisted on elevation. The rest of the leg was warm. No arterial pulses were palpable. There was absence of light touch sensation on the toes, and all movements of the extremity were limited by pain and œdema. There was neither excessive pilomotor activity nor undue prominence of the subcutaneous veins.

'Blue phlebitis' with incipient gangrene was diagnosed and the patient was treated with anticoagulants, reflex vasodilatation and elevation of the right leg.

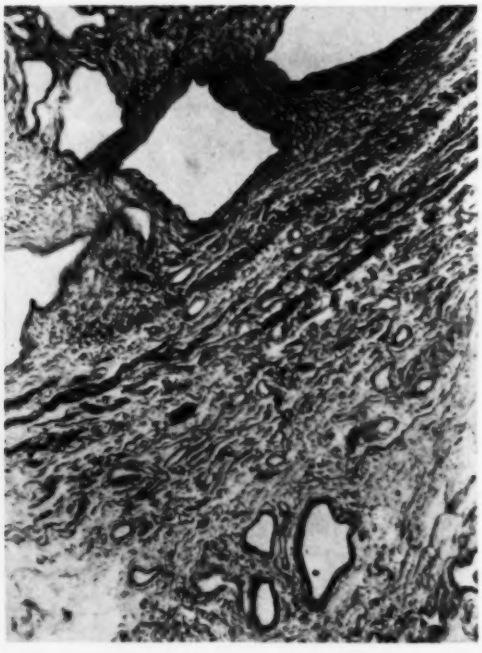


FIG. 714.—Popliteal vein occluded by organized thrombus containing vascular spaces (top left). There is much perivenous granulation tissue and infiltration of the vein wall by fibrous tissue. (H. and E.) (× 72.)

FIG. 715.—Posterior tibial vein showing early organization of thrombus. (H. and E.) (× 144.)

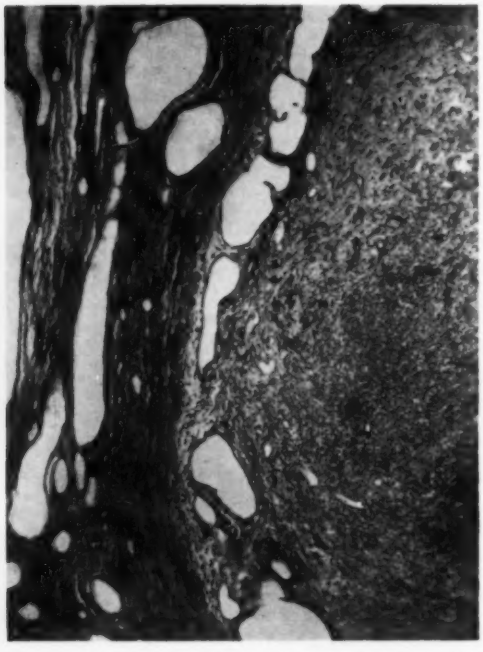


FIG. 716.—Anterior tibial vein showing recent organizing thrombus superimposed on old organized thrombus. (H. and E.) (× 144.)

FIG. 717.—Subcutaneous vein occluded by thrombus, showing early organization. (H. and E.) (× 72.)

Blood urea 74 mg. per cent, hæmoglobin 75 per cent, white blood-cells 25,000/c.mm., with 82 per cent neutrophils. Bleeding time 1·5 min.; clotting time 3 min.; prothrombin 55 per cent; platelets 76,000/c.mm. There

was slight albuminuria. A lumbar aortogram was performed and showed patent arteries of normal calibre in both legs.

Because of a sudden drop in hæmoglobin to 40 per cent, anticoagulant therapy was discontinued after 9 days, although there had been very little improvement in the condition of the right leg. Within 36 hours of this the skin of the right foot and ankle became blackened and covered with large blebs, and the entire lower leg and foot became anæsthetic, immobile, and cold. Above the level of skin blackening, the leg was a marbled dusky pink and white.

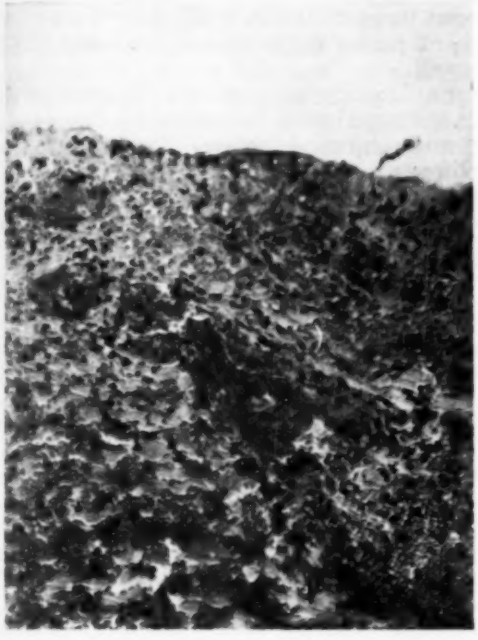


FIG. 718.—Skin and subcutaneous tissues of foot showing massive engorgement with blood and loss of epidermis. (H. and E.) (× 144.)

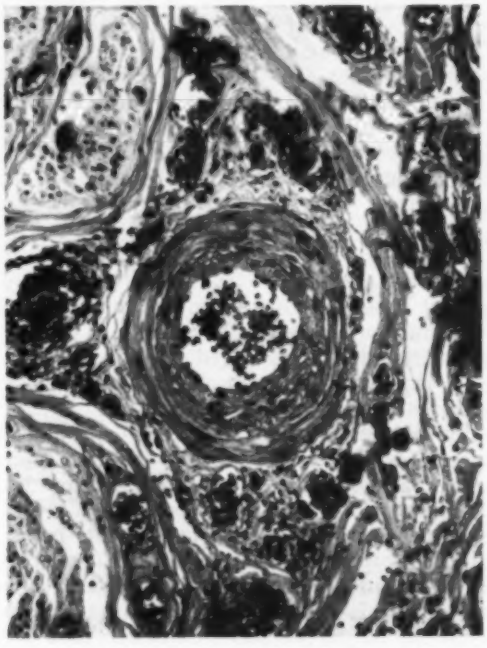


FIG. 719.—Small artery in foot showing absence of disease and patent lumen. (H. and E.) (× 144.)

On Oct. 21 a right mid-thigh amputation was performed and while there was free arterial bleeding, all visible transected veins were blocked with adherent thrombus.

Biopsy of the liver nodule on Nov. 6 showed it to be a metastatic non-mucus secreting columnar-celled adenocarcinoma.

The patient's condition gradually deteriorated and she died one month later. No post-mortem was performed.

PATHOLOGICAL REPORT.—

Macroscopical Description.—The specimen consisted of an œdematous right leg amputated through the mid-thigh. The skin of the distal half of the thigh and the proximal three-quarters of the inner leg showed a distinct blue mottling, while that of the ankle and foot was reddish-purple with subcuticular blebs and widespread sloughing of the cuticle (*Fig.* 711).

The vessels were dissected out as far as the mid-foot while the distal half of the foot, comprising the metatarsal bones and phalanges, was frozen in alcohol and solid carbon dioxide and cut into slices 5–10 mm. thick to facilitate examination of the vessels.

The dissection of the femoral and upper part of the popliteal veins was made difficult by the presence of considerable perivascular fibrosis. Elsewhere this fibrosis was absent and the vessels were easily removed.

There was marked œdema of the muscles and subcutaneous tissues throughout the whole specimen, while in the foot and ankle these tissues were heavily engorged with blood.

Apart from occasional plaques of early atheroma the main arteries and their muscular branches were patent.

The femoral and popliteal veins were occluded by pale firm adherent thrombus (*Fig.* 712 A). The terminal part of the posterior tibial vein, together with its muscular tributaries, was occluded by firm dark adherent thrombus. The anterior tibial vein at that level was blocked by dark thrombus superimposed on a honeycombed tissue (*Fig.* 712 B). Below this level the anterior and posterior tibial and peroneal veins were everywhere occluded by a similar honeycombed tissue with superimposed dark thrombus in varying proportions.

The long and short saphenous veins, as well as the small subcutaneous veins of the thigh and lower leg were occluded by dark thrombus as were the subcutaneous and deep veins of the foot (*Fig.* 713).

Histological Appearances.—The walls of the femoral and popliteal veins were heavily infiltrated with, and in places, largely replaced by lymphocytes, macrophages, and fibroblasts. There was a marked amount of perivenous granulation tissue, while the thrombus within the vein lumen showed advanced organization with numerous endothelial-lined vascular spaces (*Fig.* 714).

The thrombus blocking the posterior tibial vein was of more recent origin showing early organization with the formation of small vascular spaces at the edge of the thrombus and there was no inflammation of the vein wall (*Fig.* 715).

The anterior tibial vein as well as the anterior and posterior tibial and peroneal venæ comitantes contained organized thrombus with numerous large vascular spaces on which was superimposed more recent thrombus undergoing organization (*Fig.* 716).

The small subcutaneous and deep veins both above and below the level of skin change contained recent thrombus showing early organization (*Fig.* 717).

The subcutaneous tissues of the thigh and lower leg contained occasional small aggregates of red blood-cells, while those of the foot and ankle were heavily engorged

with blood and in places the epidermis had been completely shed (*Fig.* 718). This engorgement was more marked in the superficial than in the deep tissues.

Apart from minor atheromatous changes the main arteries were normal and extensive examination of the small arteries of the foot failed to reveal any occlusion (*Fig.* 719).

DISCUSSION

The patient had gangrene of the right foot and lower leg of venous origin.

This condition occurs with nearly equal frequency in males and females, usually between the second and fifth decades and involves the lower extremity in 80 per cent of the cases (Haimovici, 1951). It rarely affects healthy individuals, although it has followed trauma (Pringle, 1938) and vein ligation (Dennis, 1945 ; Veal, Duggan, Jameson, and Bauersfeld, 1951). Cases have been reported in postpartum females (Tilley, 1938) and in chronically ill patients suffering from ulcerative colitis, intra-abdominal sepsis (DeBakey and Ochsner, 1949), as well as pulmonary infections (Audier, 1936) and malignant neoplasms (Gaillard, 1894).

The rapidity of onset is extremely variable. Some cases are instantaneous and simulate arterial occlusion, while in others the gradual progression of thrombophlebitis antedates cyanosis and gangrene by many days or weeks (Bergeret, Guillaume, and Delarue, 1932). The case reported falls into the latter group and had several thrombotic episodes.

The symptoms and signs vary in their order of appearance and severity. Pain is usually the first symptom. It is severe and is located in Scarpa's triangle, the thigh, or calf. Cyanosis, or a red discoloration, is a constant sign and appears rapidly in the fulminating cases. In view of the extensive thrombosis of the subcutaneous and deep veins seen in this case, it is not surprising that cyanosis persisted on prolonged elevation. Persistence of discoloration on elevation may be a useful sign in differentiating between 'blue phlebitis' and arterial occlusion. Œdema is also an invariable finding but may not appear for hours or days after the onset of pain. The absence of palpable peripheral pulses is misleading, for in some sudden cases they have been impalpable before œdema has appeared. This may be due to associated arterial spasm as postulated by DeBakey and Ochsner (1940) but in many cases it is probably the result of peripheral circulatory failure. Skin temperature may be as misleading as the absence of pulses, especially in the rapidly progressing cases in which the leg has been reported to cool quickly (Morgan, Allen, and MacCarty, 1948).

The differentiation between arterial occlusion and 'blue phlebitis' of sudden onset is sometimes difficult. In these cases lumbar aortogram is most helpful and is superior to peripheral arteriography, which will not show an iliac artery occlusion.

Haimovici (1951) reported that in the majority of cases the thrombosis commenced in the small peripheral veins and spread to the larger trunks. In this case there is a close correlation between the history of several thrombotic episodes beginning in the thigh and progressing distally and the pathological findings of widespread thromboses of varying ages.

The presence of considerable immature fibrous tissue around the femoral and popliteal veins, indicating a previous periphlebitis, was not accompanied by clinical evidence of arterial spasm, which has been put forward as a possible cause of absent peripheral pulses and ischæmia (DeBakey and Ochsner, 1949).

Approximately 40 per cent of cases are fatal. Death is caused more frequently by circulatory collapse and chronic debility, than by pulmonary embolism.

The cause of this condition is obscure and pathologically it differs from other venous thromboses only in its massive extent.

Treatment.—Treatment should be conservative. The need for adequate blood and fluid replacement, especially in the acute stages, cannot be over-emphasized. Anticoagulants and elevation of the extremity are equally important. Lumbar sympathetic block, vigorous exercise of the limb, and vena cava ligation have been used, but the number of cases treated by each is small and the results equivocal.

Wet gangrene is the rule and is usually extensive enough to require some form of surgery. In most cases the gangrene is confined to the superficial tissues and the deep tissue loss is small. The best functional results have been obtained by débridement of the obviously necrotic superficial tissues followed in time by skin grafting (DeBakey and Ochsner, 1949).

We are indebted to Professor C. G. Rob, F.R.C.S., and Mr. J. Joyce, F.R.C.S., for permission to publish this case. We are also indebted to Mr. A. Beasley, F.I.M.L.T., and the Photographic Department of St. Mary's Hospital Medical School for technical assistance.

REFERENCES

AUDIER, M. (1936), *Paris Méd.*, **1**, 384
BERGERET, G., GUILLAUME, A. C., and DELARUE, J. (1932), *Ann. Anat. path. méd.-chir.*, **9**, 536.
CRUVEILHIER, J. (1862), *Traité d'Anatomie Pathologique Générale*, **4**, 288. Paris : J. B. Baillière et Fils.
DEBAKEY, M., and OCHSNER, A. (1940), *J. Amer. med. Ass.*, **114**, 117.
— — — — (1949), *Surgery*, **26**, 16.
DENNIS, C. (1945), *Surgery*, **17**, 264.
GAILLARD, L. (1894), *Bull. Soc. méd. hôp. Paris*, **11**, 315.
HAIMOVICI, H. (1951), *Circulation*, **1**, 225.
HEUTER, J. (1859), *Virchows Arch.*, **17**, 482.
MORGAN, E. H., ALLEN, E. V., and MACCARTY, C. S. (1948), *Proc. Mayo Clin.*, **23**, 425.
PRINGLE, J. H. (1938), *Glasg. Med. J.*, **129**, 126.
TILLEY, J. H. (1938), *Amer. J. Obstet. Gynec.*, **36**, 157.
VEAL, J. R., DUGGAN, T. J., JAMESON, W. L., and BAUERSFELD, R. S. (1951), *Surgery*, **29**, 355.

ATYPICAL HEAD INJURIES ILLUSTRATING GENERAL THERAPEUTIC PRINCIPLES

By C. B. SEDZIMIR

CONSULTANT NEUROLOGICAL SURGEON, LIVERPOOL

The three cases of head injury described in this communication are of great interest and of sufficient rarity to merit their publication. Apart from this, each of these patients was admitted to a general surgical service and might well have had to be treated without the benefit of a neurosurgical opinion. The post-operative management, including the use of chlorpromazine and induced hypothermia in the first case, the surgical procedure adopted in the second, and the diagnostic uncertainty of the third case are of the utmost instructive value to a general surgeon as well as to a neurosurgeon. The experience with the first case brings forth the lesson that even the most severe head injury should not be abandoned and that 'conservative' therapeutic measures and skilful nursing may at the end be rewarded.

THE USE OF CHLORPROMAZINE AND INDUCED HYPOTHERMIA IN HEAD INJURIES

The popularization of induced hypothermia by the French workers Laborit and Huguenard (1954) has opened new fields for laboratory research and for its experimental application into clinical practice. Woringer, Schneider, Baumgartner, Thomalsky, and Scheidegger (1954) reported their experience with induced hypothermia in 19 cases of brain-stem injury selected for their gravity from 270 cases of head injury with unconsciousness.

BRAIN-STEM INJURY

The patient described below suffered from a severe primary brain-stem lesion. This case illustrates certain hitherto unreported observations on the use of chlorpromazine and cold sponging in the management of post-traumatic hyperthermia, and on their effect on decerebrate posture. To a lesser extent it illustrates the full technique of induced therapeutic hypothermia.

Case 1.—A boy, aged 6 years, was knocked down by a motor cycle and admitted to The Liverpool Neurosurgical Unit on Sept. 3, 1954, within one hour of the accident.

On Examination.—Subgaleal hæmatoma and superficial abrasions were visible over the forehead. Nuchal muscles were transected on the left side. In the depth of the wound there was a comminuted fracture of the occipital bone. He was unconscious. On the slightest stimulation all limbs assumed decerebrate posture but between these spasms spontaneous movements were observed. Plantar responses were bilaterally extensor. The pupils were medium in size and reacted to light. Optic fundi were normal. The pulse was rapid and thready. Blood transfusion was commenced and the patient was taken to the operating theatre.

At Operation (Anæsthetist, Dr. I. Francis).—Midline cerebellar incision was used meeting the traumatic wound about its centre. The contaminated skin and muscle were narrowly excised and the fracture was exposed. The comminuted fragments were nibbled away as far medially as the foramen magnum and laterally to the mastoid process. About 2 cm. of the sigmoid sinus were thus exposed and it was intact. The dura over the left cerebellar hemisphere was found to be punctured by the sharp edge of a bony fragment. The cerebellar cortex showed a small area of contusion. The dura was sutured and the wound was closed in four layers with drainage.

Before the patient was removed from the table, radiographs of the skull and cervical spine were taken and revealed no further damage to the bony structures.

Post-operative Course.—On return to the ward the temperature was 100° F., pulse rate 140 per minute and respirations 32 per minute. Half hourly T.P.R. was

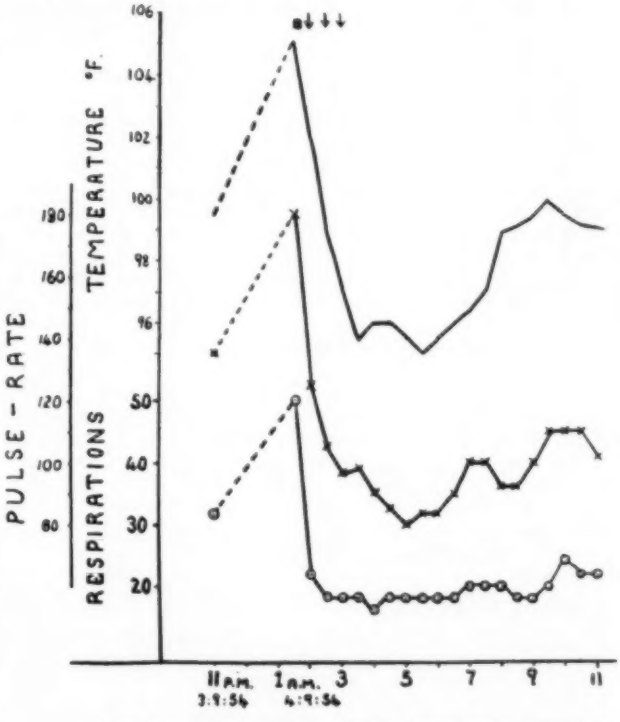


Fig. 720.—*Case* 1. Post-operative chart showing pulse-rate, temperature, and respirations. Cold sponging ↓; Drugs ■.

ordered but was not kept owing to a misunderstanding. On Sept. 4 at 1.30 a.m. (about three hours after the operation) I found the boy in the following condition. Both legs were poker stiff in extension and the feet plantar-flexed. The arms were extended, hands pronated, and the fingers tightly flexed with the thumb gripped between the index and middle fingers. The body was held in rigid opisthotonos and the muscles of the trunk were standing out like those of an anatomical sculpture. From time to time, the face would begin to twitch, the right arm to perform a few wild myoclonic-like jerks, not conforming to a repetitive pattern, while the right leg, still in the position of decerebration, would flex and extend violently at the hip. Each time the leg hit the bed the whole body would jerk up in the air. The temperature was 105° F. The pulse-rate was practically uncountable and the respirations were about 50 per

minute. He was covered by three blankets and a 'special' nurse sat beside him.

The patient was stripped. Chlorpromazine 50 mg., pethidine hydrochloride 25 mg., and phenobarbitone sodium gr. 3 (200 mg.) were given intramuscularly with hyaluronidase. First tepid, followed by iced, water sponging was resorted to. Within one hour the temperature was 99° F., respirations 18 per minute and pulse rate 90 per minute (*Fig.* 720). The fall of the temperature continued to 95° F. without further sponging and then rose to 99° F. at 8 a.m. During this period the boy was completely relaxed. The limbs were flaccid. The posture of the head and of the body was normal for a person in a deep sleep. If stimulated, some tone

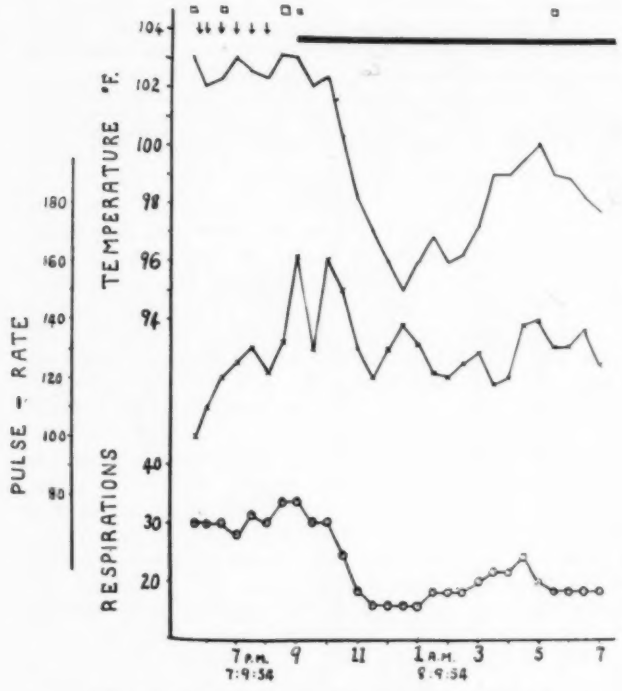


FIG. 721.—*Case* 1. Charts after induced hypothermia. Cold sponging ↓; Drugs □ □; Ice ▬▬.

appeared in the limbs but the decerebrate posture was not assumed. From 8 a.m. until midnight the temperature remained at 100° F. level. The state of consciousness was not altered. The limbs were moderately rigid and in a mild decerebrate posture. On Sept. 5, the temperature fluctuated at about 99° F. and the neurological picture was unchanged. In the afternoon, however, it began to rise in spite of renewed sponging with iced water. The spasms of profound decerebrate posture were again observed. At 4.30 p.m. when the temperature reached 102° F., chlorpromazine 25 mg. and levorphan 2 mg. were injected and the sponging was repeated. One hour later the temperature was 99° F. and the spasms disappeared though some rigidity of the limbs remained.

On Sept. 7 the temperature had risen to 103° F. Profound decerebrate rigidity and jerking movements of the right limbs occurred. The patient was more deeply unconscious with a pulse-rate in the region of 160 per minute. This time, despite injections of drugs and frequent sponging, there was no improvement of his condition. It was decided to resort to the full technique of induced hypothermia, by the application of ice bags.

THERAPEUTIC HYPOTHERMIA (9 p.m.)—Great difficulty was encountered in the stage of induction but finally the temperature was reduced to 95° F. and the spasms disappeared although considerable rigidity of the limbs remained. For details of hypothermia see *Fig.* 721. At about 6 a.m. on Sept. 8, he began for the first time to respond to stimulation with a noise reminiscent of a meningitic cry. The ice bags were removed at 10 a.m. but the patient was left exposed under a tray filled with ice and suspended over his body from a cradle. On Sept. 11 he opened his eyes and blinked promptly in response to light stimulus. On three occasions during the following two days the temperature rose to 104° F. with concomitant spasms of decerebrate posture and minor attacks of jerking of the right lower limb. On each occasion chlorpromazine 50 mg. and levorphan 2 mg. were given followed by sponging, with abolition of the spasms and reduction of the temperature. On Sept. 16 he recovered the chewing reflex, but surprisingly, the sucking reflex was still absent. When given a feeding-bottle he chewed the teat. On Sept. 20, he was crying more like an ordinary child and kept his eyes open most of the time, following activities with a vacant gaze. Two days later he began to take sips of water and on the following day he recognized his mother and attempted to put his arms round her neck. A few days later, exactly 25 days after his injury he uttered his first word. He said "Yes please" when offered a grape. The mode of speech was most interesting. The words were slurred and the tone was high-pitched, not unlike the whistling of a passing train, i.e., "yyyYYYYEEEESSSsss ppllEEEESsss". His head was constantly flexed and when he attempted to sit up he would jerk the whole body forward until the nose almost touched the knees, after which he would straighten himself a little. The movements of the right upper limb, though purposeful, were inco-ordinated and there was a considerable tremor. The left hand, which was congenitally deformed, was used very little. The tone of all limbs was moderately increased. Four days later he began to speak freely and could recognize the nursing and medical staff. He was emotionally very labile but cheerful for most of the time. After a further two days he went to the gymnasium for his first lessons in walking, a performance which he enjoyed immensely. His appearance was quite grotesque, the head hanging forwards and the body thrown back to such an extent that it would have been impossible even for a trained gymnast to keep balance. He lifted his legs in a jerky inco-ordinated manner and put them down sometimes with force, thumping on the floor. Sometimes the foot would not reach the goal and the step would be completed in the air, a fall being prevented by the supporting physiotherapist. Forty-eight days after the injury he was able to walk all over the hospital unassisted. His memory for the events before the accident seemed unaffected though one could not estimate the length of retrograde amnesia. Post-traumatic amnesia extended for about twenty days.

He was discharged home on Oct. 20, and re-examined on Dec. 17. Apart from the inability to run he could walk normally and negotiate steps. His speech was still slightly slurred and he was reluctant to meet strange children, although perfectly happy in the company of adults. On examination the cranial nerves were normal. There was a slight tremor of the upper limbs and slight spasticity of the lower limbs. Reflexes were brisk with clonic ankle jerks and extensor plantar responses. He was reported to have begun taking lessons at home and was able to memorize them. In March, 1955, he was back at school, top of his class, and could run and play games.

Discussion.—Hyperthermia, hyperpnœa, tachycardia, and decerebrate rigidity, constitute a well-known syndrome of grave prognosis resulting from a lesion of hypothalamic-brain-stem complex. It may be due to a primary injury to these structures or secondary to shifts and tentorial herniation

resulting from an expanding intracranial lesion. The latter, in the case of head injury, may be a massive extradural, subdural or intracerebral hæmorrhage or œdema of the brain. In both instances the disturbance of vascular supply to these midline structures will result in ischæmic or hæmorrhagic lesions. While an ischæmic lesion may occasionally be reversible, recovery probably never occurs after the hæmorrhagic type. Few cases are recorded of survival once these grave signs have appeared and fewer still whose physical and mental faculties remain satisfactory. The successful outcome in this case is thought to have been due largely to the use of chlorpromazine and surface cooling. In this Unit, this form of therapy has been applied in five cases of primary brain-stem injury to date. Three patients have recovered. In two cases a tracheotomy was also performed in order to overcome respiratory obstruction and proved of great value in relieving cerebral congestion. Four other cases of severe head injury were similarly treated with three survivals.

Sponging with tepid or iced water in cases of hyperthermia following head injury is a valuable and long-recognized therapeutic measure. There are occasions, however, when the temperature can be reduced only insignificantly or entirely resists all attempts at cooling by sponging alone. The use of chlorpromazine and an analgesic (pethidine or levorphan) increases the efficacy of the sponging procedure as shown by the results in this patient and in the one described in the second section of the present communication.

In addition to the drop in temperature there was often a marked diminution or even complete abolition of the decerebrate posture, but this effect was not constant.

When these simpler measures fail a more effective method of surface cooling must be used (*Fig.* 721). The patient is covered with ice bags and the temperature is allowed to drop if necessary to a level of 90° F. but not below. The reduction in metabolism and cerebral oxygen consumption may allow survival and continued function of neural tissue in areas rendered ischæmic by circulatory embarrassment (Sedzimir, Jacobs, and Dundee, 1955).

Once the hypothermia is induced and the improvement in the patient's condition is apparent, it is essential that it should be maintained until there is no deterioration, when the temperature may tentatively be allowed to rise towards normality. Any sign of deterioration demands an immediate reinduction of hypothermia. When there is no definite improvement in the patient's condition under the moderate degree of cooling advocated here, the brain-stem injury is certainly irreversible.

The application of hypothermia in addition to the care of respiratory embarrassment and unfailing general nursing is the sum total of the treatment that can be offered in primary brain-stem injuries. The hypothermic régime for head injuries evolved in this Unit and recommended for a general trial is :—

1. Half-hourly pulse, respirations, and *rectal* temperature.

2. Chlorpromazine 50–100 mg. with or without pethidine 25 mg. or levorphan 2 mg. (and occasionally sodium luminal gr. 3) intramuscularly.

3. After injection of the drugs the patient is left with a sheet only and 30 minutes later, tepid, followed by cold, followed by iced, sponging is instituted until the temperature falls to the required level (93°–90° F.).

4. More drugs may be required and ice bags applied over the heart and major vessels if the temperature does not fall satisfactorily.

5. Air-passages should be kept free. Intubation or tracheotomy where indicated.

6. Fall of temperature below 90° F., or rise above 100° F., irregularity, slowing, or rising of the pulse-rate and/or respiratory-rate, deterioration in responsiveness, and any fits or paralysis, should be immediately reported to the surgeon.

IMPALEMENT OF SKULL

The second case is that of a boy whose right hemisphere had been transfixed longitudinally by an iron rod. This patient received considerable journalistic publicity which was regrettably unavoidable.

Case 2.—A boy, aged 8 years, sustained a penetrating injury while at play with his brother, aged 12 years, on Aug. 22, 1954. An iron rod over 3 ft. long and ¼ in. in diameter was thrown like a javelin and hit the patient in the right occipital region. It traversed the whole length of the right hemisphere and emerged through the frontal bone (*Figs.* 722, 723). The subsequent events were confused by a number of witnesses giving contradictory accounts but on admission to hospital, half an hour after the injury, the boy was conscious. He seemed to understand commands but would not speak or cooperate.

On Examination.—The pupils were equal, medium in size, and reacted to light. There was a right abducens palsy. The left leg seemed to move normally but the left arm was paralysed. The patient was lying on his left side with blankets supporting his back and preventing the iron rod from being moved against the stretcher. The ambulance men certainly did their job well. From the position of the rod it was clear that it was very close to the lateral sinus. The boy was shocked and shivering. He was moved to the operating theatre where a blood transfusion was set up. He was anæsthetized and intubated (Dr. E. Gallagher) and the head shaved.

First Operation.—After cleaning the scalp, the short end of the rod was washed several times in spirit and saline. The rod was removed after disengaging it from the grip of the frontal bone by gentle rotation. The scalp around the wound of entry was excised and incorporated in a curved incision exposing the comminuted fracture of the occipital bone. The fragments were gently nibbled away and from the start there was a profuse hæmorrhage. This was partly controlled by a finger whilst the craniectomy was being enlarged to expose more of the lateral sinus. The sinus was found to be torn. In spite of rapid transfusion under pressure the patient's condition gave rise to anxiety. Artery forceps were applied to both sides of the tear to control the hæmorrhage. A few small fragments of bone and some blood clot were removed from the occipital lobe. The frontal wound was now rapidly excised and a cortical vessel was diathermized. A rubber catheter was threaded along the whole length of the hemispheral wound which was thoroughly washed out with warm saline. When the returning fluid was clear, the frontal defect was covered with a sheet of fibrin foam and the wound was sutured. A gauze pack was inserted into the occipital wound and the scalp flap was sutured over it and over the emerging artery forceps.

POST-OPERATIVE COURSE.—Two hours after the operation he was still unconscious. On stimulation he moved his limbs vigorously with the exception of the left arm. The temperature was 103° F., respiratory and pulse rates were 44 and 180 respectively. He was stripped and sponged with tepid, followed by iced, water with little effect on the temperature. Injection of 50 mg. of chlorpromazine and 25 mg. of pethidine in hyaluronidase was given intramuscularly and he was again sponged several times. One hour later the temperature was 97·4° F., pulse rate 110, and the respirations 28 per minute. At this stage he regained consciousness, told his name when requested, and asked for a drink of 'pop'. This lucid interval was short and he became unconscious again. At 2 p.m. on Aug. 23, he became fully conscious and remained so from then onwards. He talked a lot to his mother and father and called his brother a big 'dope' for causing his injury, of which he had a full recollection.

SECOND OPERATION.—Aug. 26, 1954. The occipital wound was reopened. The artery forceps were removed. The sinus was not thrombosed but the bleeding was only moderate and easily controlled by the application of silver clips (*Fig.* 724). On Aug. 30, the parenteral administration of penicillin and streptomycin was stopped. Neurological examination showed a left homonymous heminanopia. The power of the left upper limb was almost normal to clinical tests but the boy completely neglected it and insisted on doing everything with his right hand. He was unaware of the visual defect and compensated for it very well. Sensation, including stereognosis, was normal in the left hand. Three days later he was playing games with other boys in the gymnasium. His visual orientation appeared normal and he certainly never lost himself in his rather extensive explorations of the hospital.

FIG. 722.—*Case* 2. Showing entry wound.

FIG. 723.—*Case* 2. Showing exit wound.

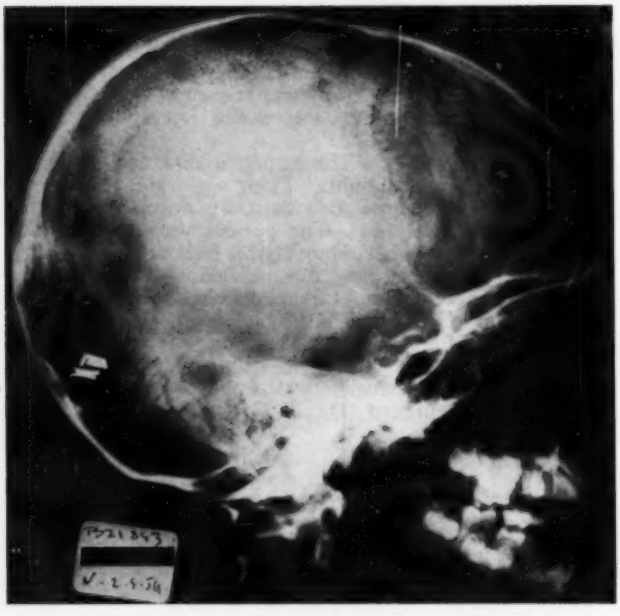


FIG. 724.—*Case* 2. Silver clips and cranial defects.

On Sept. 18, he was discharged home after an electroencephalographic examination which merely indicated the recent serious injury involving predominantly the right hemisphere. He was seen in the Out-patient Department and had a second electro-encephalographic examination on Jan. 12, 1955.

The neurological condition was unchanged except for a mild spastic foot-drop which his mother first noticed about two weeks ago. He could read fluently and the spontaneous drawing of a house and a daisy, as well as the copying of geometrical designs, were correctly performed. His mother informed us that his activities had become as wild as before the accident. He attended school and was making satisfactory progress. He was taking regularly one grain of phenobarbitone at night.

Dr. R. R. Hughes reported on the electro-encephalogram as follows :—"At rest, there was a certain amount of 8–9 per second alpha activity, but this was comparatively small in amount and was almost completely masked by generalized slow activity, which was largely within the theta range.

"In general, I think that the slow activity is rather less in amount than on the previous recording in September. Then, there was a considerable amount of delta activity, whereas there is now a considerable amount of theta activity. In previous recordings there were occasional spikes occurring in all areas, but this abnormality has now resolved itself into a focal spike arising from about the centre of the right hemisphere. This is clearly seen, both in the standard arrays and in the transverse arrays.

"The present record would suggest that the generalized brain damage is gradually settling down, but the boy is developing an irritable focus in the right hemisphere."

Discussion.—Dawson (1954) reported a case of a baby whose head was transfixed by a metal spike through the frontal region in a coronal plane. Removal of this was followed by an uneventful

recovery and apparently no neurological deficit was elicited. On perusal of the literature of the last thirty years, I could not find another example of a similar nature. There is an anecdote told in neurosurgical circles of an orthopædic surgeon who transfixed the head with a Steinman's pin for the purpose of applying skeletal traction in a fracture-dislocation of the cervical spine.

The total neurological disability in this present case comprises to date a left homonymous hemianopia, of which the patient is not aware, a profound motor neglect of the left upper limb (Macdonald Critchley, 1953) which was originally totally paralysed, but the power of which has recovered practically to normal, and a mild degree of left foot-drop of recent onset.

The second electro-encephalographic examination shows an obviously irritable focus in the centre of the right hemisphere. It is possible, therefore, that the patient may develop fits in the future and a strict anticonvulsant régime is being pursued as a precautionary measure.

CHRONIC EXTRADURAL HÆMATOMA

Extradural hæmorrhage is justly regarded as the most acute emergency in the field of head injury. It usually manifests itself clinically within a few hours of the trauma, which is not infrequently of a minor nature. Unless the hæmatoma is promptly evacuated and the bleeding arrested, tentorial herniation and consequent brain-stem damage normally results in a fatal outcome within 48 hours, whilst timely operation can be life-saving. Careful history-taking is of paramount importance. A lucid interval after the injury is the rule, almost without exception. As soon as the enlarging hæmatoma compresses the brain and induces lateral shift consciousness deteriorates and progresses to coma. The onset of tentorial herniation is heralded by an enlarging pupil which loses its reaction to light. This important sign, which should not, however, be taken out of context of the whole clinical picture, is due to interference with the oculomotor nerve by the herniating hippocampal gyrus. Strangely enough other muscles inervated by the oculomotor nerve are rarely paralysed though some degree of ptosis is not infrequently seen. Decerebrate rigidity follows and the end is in sight.

The presentation and progress of the patient here reported defied practically every established rule and the actual diagnosis only became apparent at surgical exploration four weeks after the injury.

Case 3.—On Feb. 17, 1953, a girl aged 12 years, fell at home and struck the right side of her head against a fireguard. She did not lose consciousness but vomited a few times and complained of headache. She was put to bed and a few hours later, still vomiting, was examined by the family doctor. He found a complete oculomotor palsy on the right side with the exception that the right pupil, though moderately dilated, still reacted to light. Two days later she was admitted to this Unit via a local hospital. Vomiting had stopped and the headache was subsiding.

On Examination.—She was orientated, co-operative, mentally bright, talkative, and took an immediate and active interest in occupational therapy. There was a minor abrasion over the right eye. The optic fundi and fields of vision, as well as the visual acuity, were normal. The right pupil was larger than the left but it reacted well to light. Limitation of the upward, downward, and inward movements of the right eye was only slight and there was some drooping of the upper eyelid. No other neurological abnormality was elicited. A telephone inquiry confirmed that the third nerve palsy had indeed been previously complete. Radiological examination of the skull revealed no fracture.

Two weeks after the injury the palsy recovered except for a mild ptosis. She was discharged home to report to out-patients in two weeks, or earlier if anything new developed. She was re-admitted four weeks after the injury. During the interval at home she had only twice complained of headache and nausea but had remained her usual bright self. On examination she was apparently a normal child. Slight ptosis of the right upper lid was present and she complained of double vision on downward and inward gaze. Apart from a mild degree of papillœdema in both eyes there were no other abnormal signs.

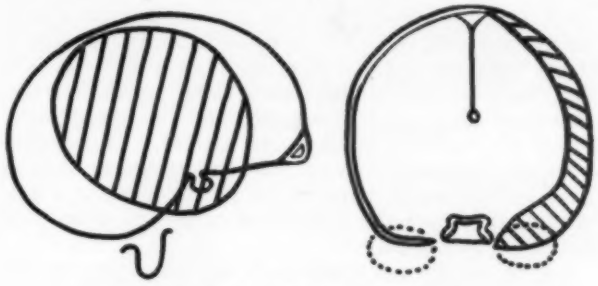


Fig. 725.—*Case* 3. Position of hæmatoma.

At Operation.—March 16, 1953. Under general anæsthesia (Dr. I. Francis) posterior biparietal burr holes were made. The brain was under tension on the right side but the pressure in the left ventricle was atmospheric. The right ventricle was not found. On exploration in the right temporal region an extradural blood clot was found. The incision was suitably enlarged and a subtemporal craniectomy was performed exposing a massive, rubbery, firm extradural hæmatoma. It extended from the region of the sagittal sinus down to the floor of the middle fossa as far as the foramen spinosum (*Fig.* 725). A small linear fracture of the temporal squama was found just above and anterior to the mastoid. The clot was removed by suction and scraping and it was remarked that its consistency was firmer than usual and it was solid throughout. The clot seemed to adhere rather intimately to the underlying dura which was extremely vascular. On the outer surface of the clot there was a thin membrane. The source of the hæmorrhage was not obvious. After the hæmostasis the wound was irrigated with penicillin and sutured over a small gutta percha drain.

Post-operative Course.—The patient went home in perfect health after two weeks with the same degree of ptosis as on her second admission. There was a trace of diplopia on looking downwards. In July, 1953, Dr. Ellis reported that she was well and making normal progress at school. Partial ptosis persisted but there was no double vision. In November, 1954, Dr. J. Dubberley examined her by special arrangement and found no residual signs. She had been doing well at school and remained as bright as ever.

Discussion.—Complete third nerve palsy, with the exception of preservation of pupillary reaction to light, developed in this patient within a few hours of a minor head injury. Though in itself this may

have been suggestive of an acutely developing tentorial herniation, the entirely normal state of consciousness was emphatically against such an explanation. It is a very common mistake for those not intimately acquainted with the complexity of the problem to diagnose extradural or subdural hæmatoma in patients with normal or stable states of consciousness on the ground of pupillary abnormality alone.

It may be postulated that in this girl the source of extradural hæmorrhage was basal, in the middle fossa. If that were so, a tentorial herniation may have occurred before the lateral shift could have developed and thus consciousness did not deteriorate. The hæmatoma then expanded laterally over the convexity of the hemisphere. The herniation was therefore allowed to disengage and the third nerve palsy to recover to a large extent. It remains obscure, however, why even at this stage the patient preserved a most remarkable mental alertness and why at all times the pupil was relatively spared by the third nerve palsy.

A minor hæmorrhage from an aneurysm on the right internal carotid artery, precipitated by mild trauma, was here a distinct possibility. The onset of papillœdema in the third or fourth week after the injury was the first undoubted indication that a space-occupying lesion was indeed present. The nature of this came as a complete surprise at operation.

Rowbotham and Whalley (1952) published the only other " delayed " case of extradural hæmatoma (by coincidence also evacuated four weeks after the trauma). The clinical presentation of their patient differed, however, very substantially. There was the classical lucid interval, the patient was acutely ill, and the state of consciousness was profoundly depressed. Except for the presence of a membrane encapsulating the hæmatoma and the markedly increased vascularity of the underlying dura in both cases, other operative findings were dissimilar. While in their case the consistency of the hæmatoma resembled that of a chronic subdural, in the patient here presented the clot was even firmer than usual. The mechanism by which the clinical progress was explained by these authors does not seem applicable, therefore, to this case.

SUMMARY

1. Three unusual cases of head injury have been presented. These include a patient with a severe primary brain-stem lesion, another with impalement of the skull, and a case of ' chronic ' extradural hæmatoma.

2. The utmost importance of vigorous treatment of post-traumatic hyperthermia is stressed and the methods employed in the production of cooling are discussed.

3. Certain observations have been made of the effects of chlorpromazine and induced hypothermia upon decerebrate posture.

4. It is noted that a massive extradural hæmatoma may present clinically as a slowly progressive space-occupying lesion some weeks after the injury.

I wish to thank Dr. A. Skene, Physician Superintendent of Walton Hospital, for the clinical photographs, and for his guidance and handling of the ordeal of publicity in the second case.

I am indebted to Dr. J. W. Dundee for the two charts, to Miss B. Duckworth for the sketches, to Dr. M. Foley for assisting at the operation on the second case, and to Drs. T. Ellis and J. Dubberley, General Practitioners, for their kind co-operation with the follow-up of the third case. I am also indebted to Dr. R. R. Hughes, Physician to the Southern General Hospital, Liverpool, for reporting on electro-encephalographic examinations and for taking a special interest in the case.

My Ward Sisters extended to me their skilful assistance in the exacting nursing problems involved in the care of the first two patients.

REFERENCES

CRITCHLEY, M. (1953), *The Parietal Lobes*. London: Edward Arnold & Co.

DAWSON, B. M. (1954), *Lancet*, **1**, 1058.

LABORIT, H., and HUGUENARD, P. (1954), *L'Hibernothérapie*. Paris: Masson et Cie.

ROWBOTHAM, G. F., and WHALLEY, N. (1952), *J. Neurol. Psychiat.*, **15**, 64.

SEDZIMIR, C. B., JACOBS, D., and DUNDEE, J. W. (1955), *Brit. J. Anæsth.*, **27**, 93.

WORINGER, E., SCHNEIDER, J., BAUMGARTNER, J., THOMALSKY, G., and SCHEIDEGGER, S. (1954), *Anésth. Analg.*, **11**, 1.

FRACTURE-DISLOCATION OF THE TALUS IN CHILDHOOD

A REPORT OF TWO CASES

BY N. A. STEPHENS, LONDON

FRACTURE-DISLOCATION of the talus is a well-recognized but unusual condition in adults, but is very rare in children. One similar case has been found in the literature (Ferrero and Basso, 1950). These fractures may be classified in terms of the joints affected by the dislocation. The first stage consists of dislocation of the ankle or subtaloid joint. In the second stage both joints are dislocated, and commonly the neck of the talus is fractured, as in the cases described here. The third stage of dislocation is very unusual, when, in addition to dislocation of the ankle and subtaloid joints, the talonavicular joint is dislocated. A few third-stage dislocations were recorded before the introduction of X-rays, the talus presenting through the skin over the front of the ankle (McCurrich, 1941). In the second and third stages there is always severe ligamentous damage, affecting the blood-supply to

FIG. 726.—*Case* 1. Fracture-dislocation of talus.

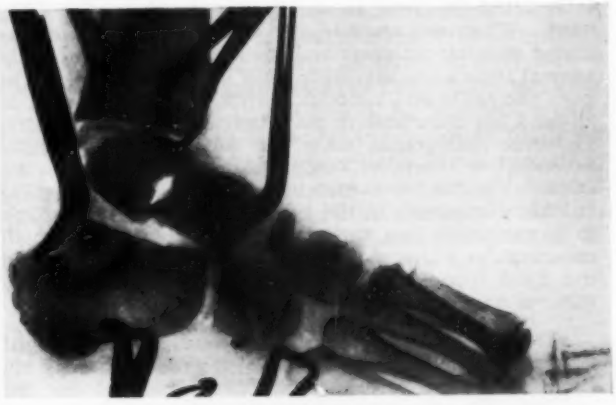


FIG. 727—*Case* 1. After operative reduction.

FIG. 728.—*Case* 1. Avascular necrosis at three months.

FIG. 729.—*Case* 1. Appearances at twenty and thirty months.

the body of the talus. Furthermore, the talus usually projects immediately beneath the skin, and there is a risk of sloughing of the skin. Bonnin (1940), who has given a great deal of consideration to the problems of classification and treatment of these injuries, states: "In children the leg breaks before the necessary force to dislocate the talus is developed, and in the old the calcaneus collapses". He also believed that the fear of necrosis of the body of the talus following dislocation is quite groundless. However, perusal of the literature suggests that it presents the major difficulty in management of all cases.

CASE REPORTS

Case 1.—D. R., a male. When 7 years old, on Oct. 15, 1943, his right knee was trapped below the seat of a rotating 'umbrella', a form of swing in a children's playground. The right foot was then suddenly struck by the ground, and forced into severe dorsiflexion.

ON EXAMINATION.—The foot was swollen and blue. No movement was permissible at the ankle-joint. The foot appeared long, and the heel fore-shortened, with rigid flexion of all the toes.

Radiographs showed a second-stage fracture-dislocation of the talus (*Fig.* 726).

AT OPERATION (Mr. H. L.-C. Wood).—An open operation was necessary, and the ankle and subtaloid joints were exposed from the outer side. The body was found lying on the inner side of the space, below and behind the medial malleolus. Reduction was effected, and the limb enclosed in a below-knee plaster (*Fig.* 727).

FIG. 730.—*Case* 1. Result after eleven years.

PROGRESS.—Within five weeks the changes of avascular necrosis were evident. Necrosis was progressing at three months (*Fig.* 728), and appeared complete at twenty months (*Fig.* 729). However, at thirty months radiographs were

interpreted in error as showing revascularization (*Fig.* 729). When the second case occurred this patient was traced after eleven years and found to have a completely normal ankle clinically, with a full range of movements in both the ankle and subtaloid joints. He has no pain at all, and has been able to play football without difficulty. However radiographs show the late stage of avascular necrosis, with vertical compression of the body of the talus. The head and neck are normal. Strangely there is little diminution in the related joint spaces, although it is presumed that the changes of osteo-arthritis will supervene at a later date (*Fig.* 730). He has at least had the good fortune to have spent his youth completely without restriction.

Case 2.—P. M., female aged 9 years. This little girl sustained a very similar injury in a playground on Sept. 20, 1953. Her left foot was acutely dorsiflexed by the platform of a see-saw machine which she was endeavouring to mount while it was in full swing.

On Examination.—An identical appearance of the foot was seen; indeed the radiographs might easily be confused with those of the first case. They showed a second-stage fracture-dislocation of the left talus (*Fig.* 731).

At Operation (Mr. N. A. Stephens).—A closed reduction proved impossible, and the talus was forthwith explored through a curved posterolateral incision. The talus was irremovably fixed in its resting place, until the calcaneofibular ligament was divided. A similar manœuvre to that of Naunton Dunn in triple arthrodesis was used, and the body of the talus then slipped back into place easily (*Fig.* 732).

Progress.—The wound healed satisfactorily after operation, and union progressed (*Fig.* 733). However the changes of avascular necrosis developed at an early stage, and are now well established (*Figs.* 734, 735).

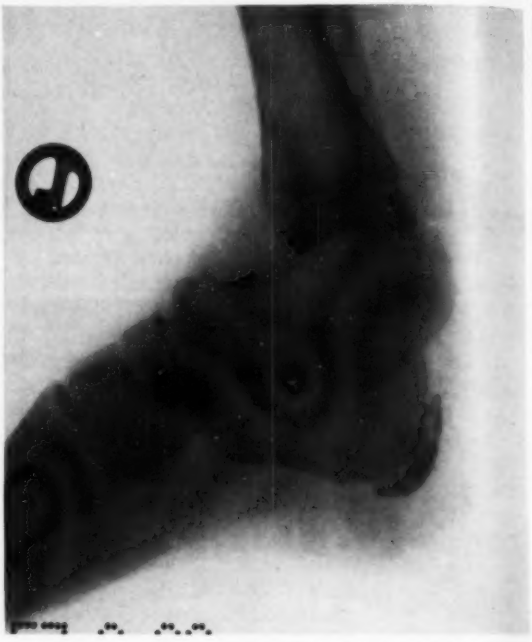


Fig. 731.—*Case* 2. Fracture-dislocation of talus.

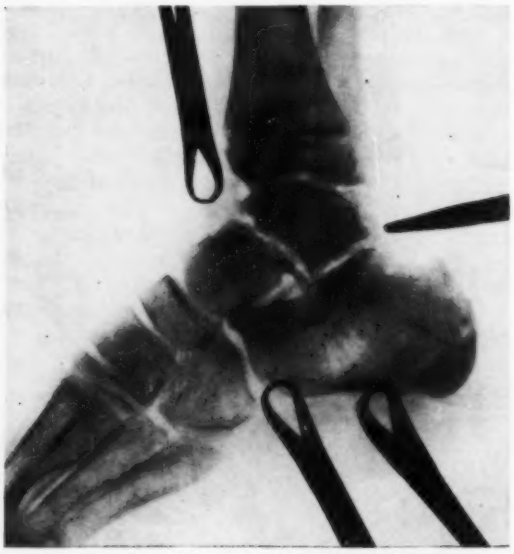


Fig. 732.—*Case* 2. Operative reduction.

Fig. 733.—*Case* 2. Early union at one month.

DISCUSSION

This injury is uncommon in adults, and rare in children. Ferrero and Basso (1950) report one case in a child of 11 years, following a fall from a height. The injury results from a force applied to the fore-foot with the leg out-stretched. It may therefore occur under the following circumstances: (*a*) A fall from a height, the patient landing on the fore-foot; (*b*) The stationary foot being struck on the fore-foot; (*c*) The moving foot being arrested by a fixed structure such as a rudder-bar in aviation accidents (Coltart, 1952).

After dislocation, the talus is almost completely divorced from its blood-supply, and avascular necrosis of the body fragment is the almost inevitable sequel. The onset of such a complication would warrant avoidance of weight-bearing for a prolonged period of time, since more weight is borne by the talus than, for example, the head of the femur. There is no doubt that in cases of Perthes' disease of the hip in children it is justified to prevent weight-bearing for a period of one year, until the head is consolidated. This is probably the ideal time for immobilization, although in both cases it proved

impossible to implement such treatment. The second case wore a patten-ended calliper for about five months only.

During the course of the operative reduction of the second case, consideration was given to the mechanism of injury. A posterolateral incision was used, as the vessels on the medial aspect were already in peril from the body of the talus, displaced below and behind to the medial malleolus. The first structures encountered were the peroneal tendons; since the peroneal retinaculum had been ruptured at the time of injury, these were overlying the fibular malleolus. They lay in a group with the sural nerve and the short saphenous vein. It was completely impossible to approach the ankle-joint in the usual manner, as there was no interval between the fibula and the tendo Achillis. Below the fibula there was an almost complete tear of the calcaneofibular ligament. In front, the anterior tibiofibular ligament was attached only to a small fragment of the fibular tubercle. Below the torn ligament there was a large cavity in which was seen the body of the talus, lying impacted on the far side—i.e., the medial side of the empty ankle-joint. Movement was readily transmitted between the mass and a hard sharp edge felt below and behind the medial malleolus. This edge proved to be the medial border of the trochlea. The mass, seen now with difficulty, tended to disappear behind the lower end of the tibia, and to sit entirely behind the ankle whenever the foot was placed in plantar flexion. All attempts at reduction, using levers behind the fibula and traction on the foot, were wasted. Finally the remains of the fibular collateral ligament were divided, whereupon the foot displaced into inversion, freeing the body of the talus. It was of course unnecessary to divide any ligaments attached to the outer side or below, since the injury had assured their total division. Complete division of the tendo Achillis was recommended by Montgomery (1917) in order to obtain sufficient access to the space to achieve reduction. This is obviously an unnecessarily severe measure. With the extensive exposure obtained it could then be seen that a fragment of the anterior part of the medial malleolus was detached by the medial (deltoid) ligament, and was lying within the joint space. The remainder of the ligament was intact between the talus and the tibia. The anterior margin of the tibia was seen to be crushed at a site corresponding to the fracture of the neck of the talus. The body of the talus was now accurately reduced.

FIG. 734.—*Case* 2. Avascular necrosis at two months.

FIG. 735.—*Case* 2. Avascular necrosis at six and a half months.

Mechanism of Injury.—The mechanism as expressed by the child was very simple. She stated that she was about to mount a playground machine, which amounts to a cross between a see-saw and a rocking horse. She raised her left foot to meet a foot bar on the front of the machine. However, she unhappily misjudged its velocity, and was hit very heavily on the forefoot. She insists very clearly that, whereas she fell to the ground at once, she did not fall on the ankle. Therefore, as far as the injury mechanism is concerned, pure forced dorsiflexion, with its accompanying eversion at the subtaloid joint, was at work. This seems to from a very remarkable parallel to the rudder-bar injury in her elders of the 'aviators astragalus' by W. D. Coltart (1952).

A very thorough analysis of the mechanisms involved is made in the series mentioned above. However, other factors appear to take some part in this case. Firstly, it is felt that the apparently insignificant fracture of the fibular tubercle is the key to the dislocation. It is presumed that the degree of dorsiflexion necessary to produce contact between the lower end of the tibia and the neck of the talus would normally be accompanied by rupture of the anterior tibiofibular ligament. It is not even necessary to postulate a terminal movement of eversion to enable such rupture (or avulsion of the fibular tubercle) to occur. Nevertheless, it seems that once such rupture has occurred, actual rotation of the trochlea may take place.

In assessing the mechanism of injury in adult fracture-dislocations, Walter Mercer (1928) felt that the rotation element in displacement of the body of the talus might be due to some ligament remaining intact. While the injury was fully exposed at operation in the second case it was seen that the medial talotibial ligament had remained intact, directing the body in its final medial direction.

From this stage onwards it is difficult to assess the order of events. Contact of the lower anterior margin of the tibia, producing a fracture just behind the neck of the talus; rupture of the talocalcaneal interosseous ligament, and of the strong posterior talofibular ligament; all of these complex injuries occur to permit the talus to slide through the gap that has now opened up between a relatively shallow tibial plafond, and a now suitably inclined and unrestricted posterior talocalcaneal joint.

From now onwards many factors influence and direct the backward displacement of the body of the talus. The tendon of the flexor hallucis longus was seen to maintain its close relationship to the posterior border of the talus. In fact it must assist to continue the rotation of the talus that is now on the point of emerging from the tibial plafond. Free play in this tendon is prevented by the rigid flexion of the hallux. Early posterior displacement of the lower end of the tibia gave the remarkable clinical features of a long foot and short heel. Both the tibia and the talus are now arrested by the right tendo Achillis. It is the early movement of both tibia and talus which prevents any further damage to the posterior part of the deltoid ligament. It is this structure which finally directs the talus, which has by now almost lost all its momentum.

J. G. Bonnin (1940) made it clear that at this stage, as witnessed in the early part of the operation from the outer side, there is no space between the rather posteriorly placed lateral malleolus and the tendo Achillis, whereas the space on the inner side remains only just sufficient to accommodate a talus displacing from an ankle which is by now "full of bone". The partly damaged deltoid ligament then directs the body of the talus to its inclined position, behind and below the malleolus, and ominously near the overlying skin. The only remaining position which it could now take up was behind the lower end of the tibia, and this was where the major portion of the bone lay when the joint was opened. The fear throughout this operation, and others previously recorded by a few authors, that the talus might fall to the floor during the open reduction, proved groundless. The body was prevented from lateral displacement by a very determined deltoid ligament, well known to be difficult to rupture, in spite of all the invitation offered by a complete and rather destructive looking approach to the joint. It was apparent that only a little more energy was required on the part of the mechanical horse to complete the ligamental damage as a final gesture.

Alternative Procedures.—

1. Closed reduction is unlikely to be successful.

2. Open reduction is necessary as described above, but avascular necrosis of the body of the talus is a natural sequel, although it was seen in the first case to be not nearly so crippling a calamity as was anticipated. It is of course acknowledged that the patient is very likely to develop trouble in later life.

3. In view of the likelihood of the development of serious symptoms from avascular necrosis, it has been suggested that subtaloid arthrodesis in the first instance would possibly save the ankle-joint by providing a new blood-supply (Miller, 1944; Boyd and Knight, 1942). This would be unlikely to produce much limitation of movement if performed in childhood.

4. Calcaneotibial fusion in the first instance results in a fixed foot, and is hardly justified when many years of freedom may be anticipated. It can still be performed at a later date if necessary (Schrock, 1943).

5. Astragalectomy is not a popular procedure, and the long-term results are poor.

6. Acrylic replacement is in general not so popular as it was a few years ago, in view of the unpredictable behaviour of acrylic materials in the human environment.

SUMMARY

Two cases of second-stage fracture-dislocation of the talus occurring in childhood are described. The lesion is a rare one.

An attempt is made to analyse the mechanism of injury.

The possibilities of treatment are discussed.

One case has been followed up for eleven years, and the results of conservative reduction have been observed.

These cases were presented at a meeting of the Orthopædic Section of the Royal Society of Medicine on Oct. 6, 1953. My thanks are due to Mr. H. L.-C. Wood for permission to publish these cases.

REFERENCES

BONNIN, J. G. (1940), *Brit. J. Surg.*, **28**, 88.
BOYD, H. B., and KNIGHT, R. A. (1942), *Sth. med. J., Bgham. Ala.*, **35**, 160.
COLTART, W. D. (1952), *J. Bone Jt Surg.*, **34-B**, 545.
FERRERO, G., and BASSO, A. (1950), *Minerva Chir.*, **5**, 384.
MCCURRICH, H. J. (1941), *Brit. J. Surg.*, **28**, 611.
MERCER, W. (1928), *Edinb. med. J.*, **35**, 465.
MILLER, O. L. (1944), *Amer. Acad. orthop. Surg. Lect.*, 147.
MONTGOMERY, A. H. (1917), *Ann. Surg.*, **65**, 495.
SCHROCK, R. D. (1943), *Amer. Acad. orthop. Surg. Lect.*, 59.

THE ANATOMY OF THE INTRARENAL ARTERIES IN HEALTH AND DISEASE*

By F. T. GRAVES
KINGS' COLLEGE HOSPITAL

JOHN HUNTER was a man of purpose. "Boldness and independence in the pursuit of truth was one of the striking characteristics of Hunter's mind. He attached no value to opinions but only to facts. Instead, therefore, of referring to the discoveries detailed in books, he appealed directly to Nature herself, until by the evidence of his own senses he had ascertained the truth."

It is my hope that this work upon the anatomy of the intrarenal arteries has to some extent been carried out in the Hunterian tradition, for the research was started as the result of a clinical observation. In 1952, I saw two cases in which removal of a stone from a calix by nephrolithotomy resulted in persistent hæmaturia which eventually necessitated nephrectomy. The loss, in each case, of an otherwise normal kidney, prompted me to investigate the vessels within the kidney substance. In 1901 Max Brodel advocated an incision on the posterior side of the lateral border of the kidney, as this site was thought to be relatively avascular. Most surgeons agree, however, that this is by no means a bloodless area.

A search through the literature of the present half century produced no evidence that the anatomy of the intrarenal vessels had been studied to any extent. The lung, on the other hand, had been studied. The bronchial segments have been described and are now well known. The question then posed itself. Is there a similar segmental arrangement of the kidney, and if so could knowledge of such an arrangement be employed in improving renal surgery?

The study of plastic casts of the intrarenal arteries of normal human kidneys (Graves, 1954) has shown that there is a segmental arrangement of these vessels which is constant, and that there is no collateral arterial circulation between these segments. On the basis of the arterial distribution the renal parenchyma is divided into five segments—the apical, upper, middle, lower, and posterior—each of which is supplied by its own artery.

FIG. 736.—The anterior view of a cast of the left kidney. Each segment has been injected with a resin of a different colour. The apical segment is green, the upper segment red, the middle segment white, and the lower segment blue. The posterior segment has been injected with a black resin. The arrangement of the anterior division arteries is that of Group III.

FIG. 737.—The posterior view of a cast of the left kidney. The posterior division and segment artery have been filled with a black resin. The posterior branch of the lower segment artery can be seen (blue resin) lying close to the terminal branch of the posterior segment vessel.

ARTERIAL SEGMENTS IN NORMAL KIDNEYS

The main stem of the renal artery divides into an anterior and posterior division as or before it enters the hilum of the kidney. The anterior division gives rise to the arteries to the upper, middle, and lower segments, and frequently also to that of the apical segment. The posterior division continues as the artery to the posterior segment.

Upper Segment.—The vessel arises from the anterior division (*Fig.* 736) and enters the segment

* Hunterian Lecture given at the Royal College of Surgeons of England on Feb. 16, 1956.

at its base. It divides into two branches—an *apical* which runs upwards and lies in front of the upper calix; a *lateral* branch which runs horizontally to supply the lateral border of the kidney.

Middle Segment.—The artery arises from the anterior division and supplies the substance on the anterior aspect of the middle calices, its terminal branches interdigitating with those of the posterior division.

Lower Segment.—The artery arises from the anterior division and passes in front of the pelvis or ureter in most cases to enter its segment, where it divides into an anterior and posterior branch. The presence and course of these two branches is so constant that the lower pole of an arteriogram can always be recognized by it. The anterior branch divides and supplies the anterior aspect of the lower calix, the posterior branch passes under the neck of the inferior calix to supply the posterior and lower aspect of the lower pole.

Posterior Segment (*Fig.* 737).—The artery is the continuation of the posterior division. It enters the posterior aspect of the hilum, running from front to back across the upper border of the pelvis of the kidney. It then passes behind and in close association with the junction of the upper calix and the pelvis, this relationship being a constant landmark. The artery then divides to form three groups; an upper group which supplies the posterior part of the upper calix; a middle group which interdigitates with those of the middle segment; a terminal group, which supplies the upper part of the lower calix, the area supplied being larger when the posterior branch of the lower segment artery is small.

Apical Segment (*Figs.* 736, 737).—The artery arises most frequently from the anterior division, but it is, however, a vessel whose origin is the most varied of all the segmental arteries. In order of frequency, it may arise from the anterior division or the upper segment, the junction of the anterior and posterior divisions with the main stem, the main stem or the aorta itself, or from the posterior division.

ARTERIOGRAPHY OF THE NORMAL KIDNEY

A number of experiments were carried out which proved that there was no collateral circulation between the segments of the kidney. One of these experiments is illustrated in *Figs.* 736, 737, which show that there is no transgression of colour from segment to segment. Although it had been shown that the plastic could penetrate the smaller arterioles sufficiently well to show glomerular tufts, it was thought that the molecular volume might be of sufficient size to prevent it passing along any small collateral channels should these exist between the segments. Arteriograms were therefore made of the renal vessels using solutions of diodone which would pass along any collateral channel which might exist.

The investigation included sixty arteriograms on the normal human kidney which confirmed both the presence of the segmental arrangement and also the absence of a collateral circulation between the arterial segments (*Fig.* 738). This method of renal and segmental arteriography was of additional value in this investigation, since not only was the segmental pattern confirmed, but by making arteriograms and segmental arteriograms of each specimen and subsequently making a cast, comparison of the two enabled one to become conversant with the radiographic appearance of the normal arteriogram.

These arteriograms of normal kidneys have also demonstrated the delicate pattern of the fine arterioles of the cortex and even the 'boutons' of the glomerular tufts can be recognized. The demonstration of this fine pattern is of importance, as it is of value to know the appearance of these vessels in health in order to appreciate their alteration in disease.

THE INTRARENAL VENOUS SYSTEM

In contrast to the intrarenal arteries, the intrarenal veins present no segmental arrangement at all, there being a free anastomosis of the venous channels throughout the kidney. John Hunter was aware of this, for in 1794 he wrote: "the veins in the spleen and kidnies anastomose in very large trunks, while the arteries do not at all".

Examination of casts and intrarenal venograms have confirmed the presence of a free anastomosis. The main venous trunks entering the hilum vary in number from one to four. Within the substance of the kidney these trunks divide into smaller branches, from between which connecting channels pass. These are most evident in the cortex of the kidney, where the smaller veins form a series of arcades (*Fig.* 739) lying mainly in the longitudinal axis of the kidney. There are smaller arcades linking those of different planes with one another. There are also anastomotic channels between the larger intrarenal veins and around the calices.

THE NATURE OF 'ABERRANT' AND 'ACCESSORY' ARTERIES

Considerable prominence has been given in the last ten years to aberrant and accessory arteries to the kidney, particularly to the lower pole, and the association of these vessels with hydronephrosis. Many cases have been described where the vessel has been divided in the belief that the obstruction to the outflow of urine will be relieved and that since the vessel is accessory to the main artery, no damage will be done to the kidney by its division.

Hitherto, the accepted view has been that the kidney is supplied by a single renal artery entering the hilum and that any additional vessel entering the organ at one or other pole is necessarily an additional and aberrant source of supply to that provided by the main stem artery. Study of this series of casts has shown that if the arteries of the renal pedicle are examined in conjunction with those within the substance of the kidney, then it becomes evident that many of the so-called accessory or aberrant arteries are in fact normal segmental arteries whose origin from the main stem is precocious.

I think that this concept is important since the ligation of a vessel on the grounds that it is an accessory artery will lead to necrosis of a segment or part of a segment.

In this present series it has been found that in 63 per cent of casts the artery to the lower segment has the most proximal origin of the three segmental arteries of the anterior division. It may arise from

the anterior division (*Fig.* 740), the main stem artery at any point between the hilum and the aorta, and not infrequently it will arise from the aorta itself.

Fig. 741 shows a photograph of a cast in which the artery to the lower segment arose directly from the aorta and was injected with a resin of a different

FIG. 738.—Arteriograms of the same kidney as seen in *Figs.* 736, 737. A, An arteriogram of all the segments. B, Segmental arteriogram of the apical and upper segments. C, Segmental arteriogram of the middle segment. D, Segmental arteriogram of the posterior segment.

colour. The artery to the apical segment has also an extra-hilar entry and there is present an accessory artery to the apical segment, arising from the artery to the upper segment.

This tendency of the lower segment artery to have its origin from or near the aorta, is probably associated with the embryological development of the

FIG. 739.—A cast of the intrarenal venous system. Note the series of arcades which run mainly in the longitudinal axis of the kidney, giving a free anastomosis.

kidney. I think that it is related to the fact that in the early existence of the mesonephros the mesonephric arteries are separate, but subsequently the more cranial arteries disappear and some of the remainder coalesce. The metanephros is therefore supplied partly by a network, and partly by separate roots at the caudal end of the kidney which have retained their individual connexion with the aorta.

FIG. 741.—The anterior view of a cast of the right kidney. The apical segment artery arises from the point of origin of the main stem from the aorta, and makes an extra-hilar entry to its segment. There is a small accessory artery to the apical segment arising from the artery to the upper segment. The artery to the lower segment arises directly from the aorta and has been injected with a resin of a different colour.

The occurrence of this network, as seen in the 18-mm. human embryo (Felix, 1912), explains why there is a variability in the point of origin of some of the persisting arteries that arise from its network and its roots.

THE SEGMENTAL ARTERIES IN TUMOURS AND CYSTS

This demonstration of the arterial pattern within the normal kidney should contribute to the knowledge and practice of surgery in two ways: first, by an addition to basic anatomical knowledge which is an essential for operative surgery, particularly partial nephrectomy; secondly, in its application to

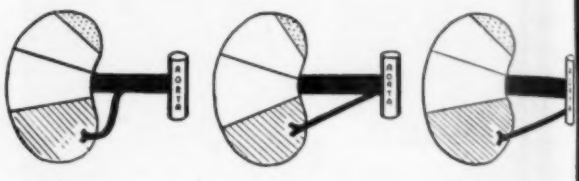


FIG. 740.—Diagram showing the variations in the course of the lower segment artery when it makes an extra-hilar entry to its segment. A, It arises near the hilum with the other segment arteries. B, It arises from the main stem near the aorta. C, It arises directly from the aorta.

angiography in the diagnosis of disease. For this information to be of full practical value, it is necessary that such changes in the arterial pattern as might be brought about by disease should also be investigated. The work was therefore continued to study the

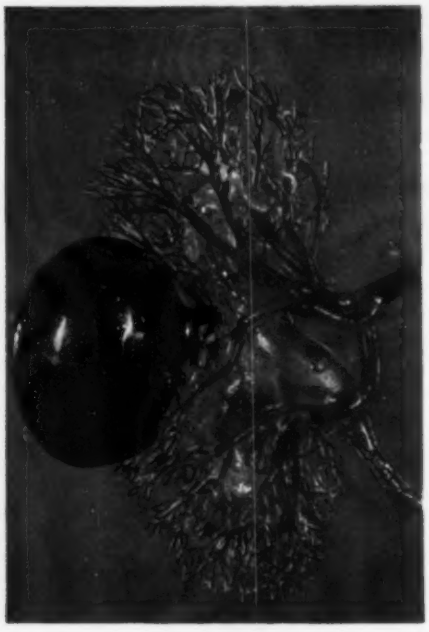


FIG. 742.—A cast of the right kidney seen from the front. The cyst in its lateral part has displaced downwards the middle segment artery, and displaced backwards the lateral branch of the artery to the upper segment. The pattern of the remaining segmental arteries is normal.

intrarenal vascular pattern in cases of renal cysts and tumours, and also in calculous disease.

Study of the vascular pattern in cysts and tumours has been done mainly because of the potential value of angiography in the differential diagnosis of these two conditions. Pyelography in such cases indicates that there is a mass compressing the calices, which may be either cyst or tumour. At operation the nature of the lesion may be obvious, but sometimes

inspection and palpation of the kidney yields little further information. Aortography is now becoming a more established procedure as a method of renal angiography, and many cases are reported in which the presence of a carcinoma of the renal parenchyma

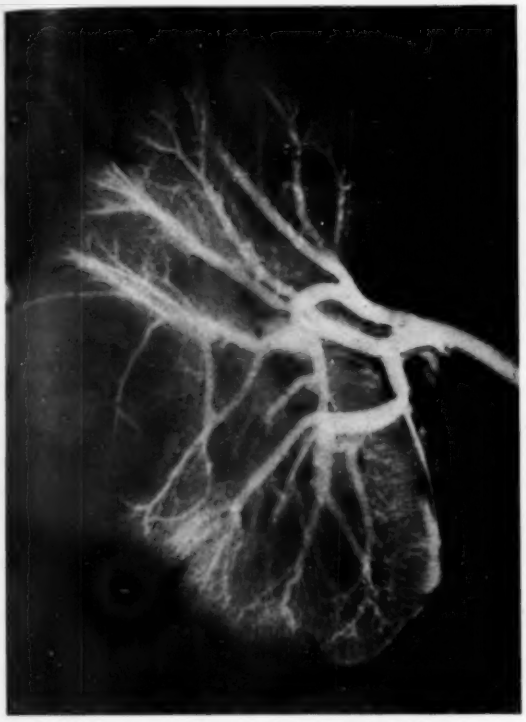


FIG. 743.—An arteriogram of the same kidney as seen in *Fig.* 472. All the segmental arteries can be seen. The cortical glomerular pattern extends to the edge of the cyst.

is indicated by ' pooling ' of the radio-opaque dye which is believed to be lying in abnormal tumour vessels (Whiteside, 1953).

Other workers have shown that in contrast to neoplastic disease a solitary cyst indicates its presence by the absence of any dye in the area of the cyst, which itself displaces the surrounding vessels. In a study of 500 cases in the literature, Walsh (1951) showed that a malignant tumour was present in 7 per cent of apparently benign cysts, and that where the contents of the cysts were hæmorrhagic the incidence of associated neoplasm was as high as 30 per cent. Reagan and Carroll (1951) have described a case in which ' pooling ' was seen around the periphery of a cyst. Malignancy was therefore suspected and subsequently proved on histological examination.

Cysts.—A cast of a kidney with a solitary cyst on its lateral border is shown in *Fig.* 742. The cyst lies mainly in the upper and middle segments. The artery to the lower segment arises as in Group I ; the artery to the apical segment arises from the posterior division. The cyst has displaced downwards the middle segment artery and displaced backwards the lateral branch of the artery to the upper segment. Apart from this the arterial pattern is normal. The arteriogram (*Fig.* 743) confirms these facts, and in addition it shows that the normal cortical pattern with glomerular ' boutons ', extends right up to the edge of the cyst. With the exception of the avascular area occupied by the cyst itself, there is no diminution of the vascular supply.

Fig. 744 shows an arteriogram of a kidney which had a large cyst at its upper pole. All the segmental vessels are intact, but the upper branches of the arteries to the apical, upper, and posterior segments are to some extent flattened by the cyst. Again a

FIG. 744.—An arteriogram of a kidney with a large cyst at its upper pole. The arrangement of the segmental arteries is normal, and the cortical pattern of ' boutons ' extends to the edge of the cyst.

normal cortical pattern with well-marked ' boutons ' extends to the edge of the cyst, which itself is avascular.

Carcinoma of the Kidney (Hypernephroma).—These three specimens illustrate tumours of early, middle, and advanced degrees of growth.

The Early Growth.—Fig. 745 is a photograph of a cast of a kidney in which there was a carcinoma at the upper pole. The growth was small and at operation the kidney looked normal, but a mass could be felt in its upper pole. The presence of a tumour had been diagnosed on the history of hæmaturia and a deformity of the upper calix on pyelography (*Fig.* 746). The cast shows the site of the tumour in the upper and apical segments, the calix being compressed by the growth. The veins in the area are intact and their normal pattern is not disturbed. The arterial supply in the area of the tumour is diminished, and the smaller branches of the segmental vessels are arranged around the tumour like ' grasping fingers '. The arteriogram confirms the findings of the cast (*Fig.* 747), showing that the apical branch of the artery to the upper segment is absent, the lateral branch being intact. The glomerular pattern in the neighbourhood of the tumour is absent.

The Growth of Middle Degree.—Fig. 748 is a photograph of a specimen with a carcinoma at its lower pole. The growth is of moderate size and its

cut surface has a characteristic appearance. The arteriogram (*Fig.* 749) shows a normal distribution and pattern of the segmental vessels in the upper half of the kidney, the arteries to the apical and upper segments, and also the upper branches of the posterior segment being well defined. The artery to the posterior segment is present, but its branches are displaced so as to follow the convex curve of the tumour. The remaining segmental vessels have disappeared and the site occupied by the tumour itself is avascular. In the area which forms the junction of normal kidney tissue with that of the tumour the branches of the neighbouring segmental vessels are pushed apart so that they appear to hold the tumour like ' grasping fingers '. In contrast to the benign cyst, the cortical glomerular pattern is not evident in this transitional zone between tumour and normal kidney.

FIG. 745.—A cast of a left kidney seen from the front. There was a small carcinoma at the upper pole. In this area the vascular supply is diminished and the apical branch of the artery to the upper segment is absent.

The Advanced Growth.—Fig. 750 A is an arteriogram of a large carcinoma of the kidney, in which growth was visible in the mouth of the main renal vein. The calibre of the intrarenal arteries is small and the normal segmental pattern is not discernible. This lack of recognizable pattern was thought to be due to the presence of nodules of growth in various parts of the kidney, and subsequent histological examination proved this to be so. The bulk of the growth lies at the upper pole, where there is little or no arterial filling. A film taken some seconds later (*Fig.* 750 B, C), by which time the dye is leaving the arterial side and entering the venous phase, shows evidence of ' pooling ', especially in the mid-zone of the organ.

These specimens show some of the arteriographic appearances of renal cysts and tumours. The area occupied by the cyst is avascular, but the segmental arterial pattern is undisturbed and the cortical pattern is normal and extends to the edge of the cyst.

FIG. 746.—An ascending pyelogram of the same kidney as seen in *Fig.* 745.

FIG. 747.—An arteriogram of the same kidney as seen in *Fig.* 745. It shows the area in the upper pole where the blood-supply is diminished, the apical branch of the upper segment being absent. There is no cortical glomerular filling in the region of the tumour.

The appearances of the carcinoma have not been uniform, but to some extent this may be due to the difference in the degree of growth. In all three specimens the area occupied by the tumour is avascular, with corresponding distortion or absence

FIG. 748.—A specimen of a kidney with a carcinoma at its lower pole.

of the segmental vessels. In the two earlier growths the arteries in the zone between tumour and normal kidney have been distorted by the tumour to appear like 'grasping fingers', but, unlike the cysts, the cortical pattern is absent in the immediate vicinity of the tumour. The presence of 'pooling' was noticed only in the specimen of advanced growth; it was also seen in the films of a pre-operative translumbar aortogram. It should be noted, however, that the 'pooling' was not seen in the arterial phase (*Fig.* 750 A), but only in the later venous phases. It is well known that hypernephroma invades the renal veins, a fact which is not surprising when one examines the extensive venous plexus shown by a cast. It has already been shown that the venous system within the kidney has a free anastomosis (*Fig.* 739). I suggest that this venous pathway within the substance of the kidney provides not only the method of spread for external metastases, but also a method of spread within the kidney itself, for such a free anastomosis provides an open back-door to every segment in the organ.

I believe that the 'pooling' so often noted is produced not by collection of the dye in abnormal vessels in the tumour, but by delayed emptying in the intrarenal venous system, which results from partial obstruction of the veins, caused by growth within their lumen. If this proves correct, then the presence of 'pooling' may be some guide to prognosis.

THE SEGMENTAL ARTERIES IN CALCULOUS DISEASE

In planning the site of resection of the kidney substance for calculous disease two factors must be considered. The extent of the calicine disease and the arterial segments which are involved.

The stone and also the diseased calicine bed in which it has matured must be removed, for, as

FIG. 749.—The arteriogram of the same kidney seen in *Fig.* 748. The segmental pattern of the arteries is normal in the upper half of the kidney. In the area occupied by the tumour there are no segmental vessels present. Note how the branches of the arteries nearest the tumour are spread over its dome.

Hamilton Stewart (1952) points out, if the deformed 'nest' or 'sump' in which the stone has matured is not included in the resected portion it will be a nesting ground for future stone formation, and, if infected, will maintain infection in the urinary tract.

The second factor, concerning the arterial segments, presents a further problem, for although the distribution, pattern, and nature of the blood-supply in the healthy kidney have been investigated, it is not known whether they will remain unaltered in a kidney affected by calculous disease. Since partial nephrectomy is being proposed for the treatment of stone, it is of importance to know to what extent the segmental arteries may be altered in the diseased kidney. An investigation was therefore carried out to answer the following questions:—

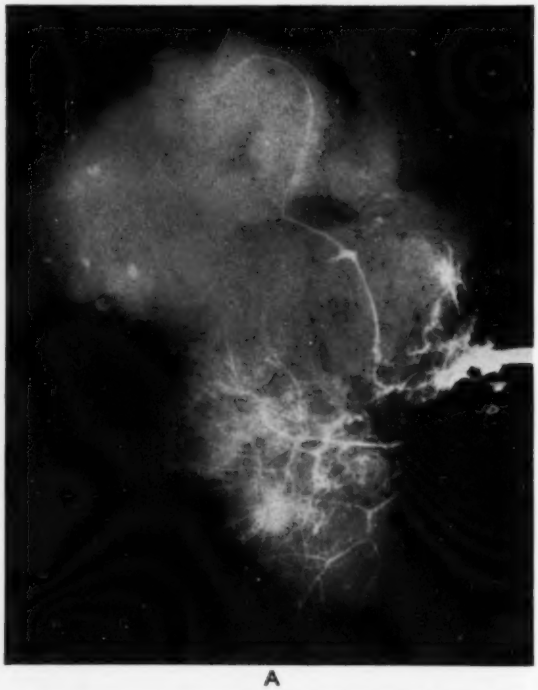
1. Is the arrangement of the segmental arteries distributed in calculous disease?

2. Is there any alteration in the calibre of the main segmental arteries?

3. Is there any alteration in the finer vessels in the cortex, particularly in those areas where the calculus lies or has been formed?

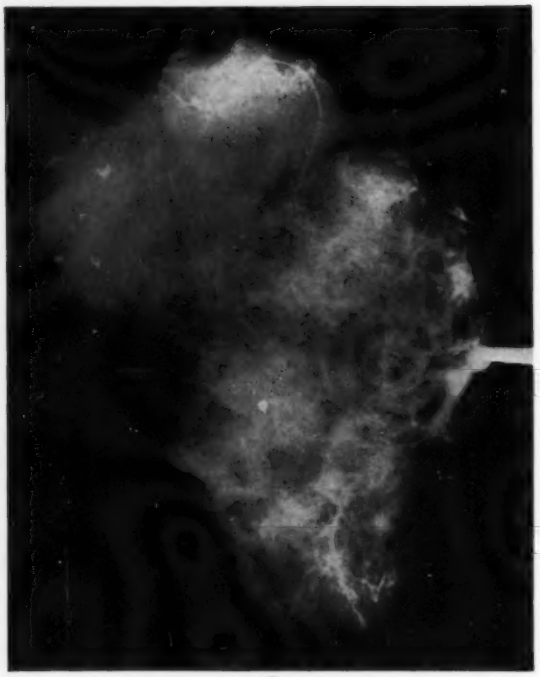
MATERIAL FOR INVESTIGATION

Both operation and post-mortem specimens were used. In order to satisfy the criteria necessary for adequate investigation, the kidney specimen had to be intact with the stone in position and sufficient length of renal artery present to ensure that all segmental arteries, however precocious their origin, would be included. This last requirement gave rise to difficulty in regard to operation specimens, since it was not always possible for the kidney to be



A

B



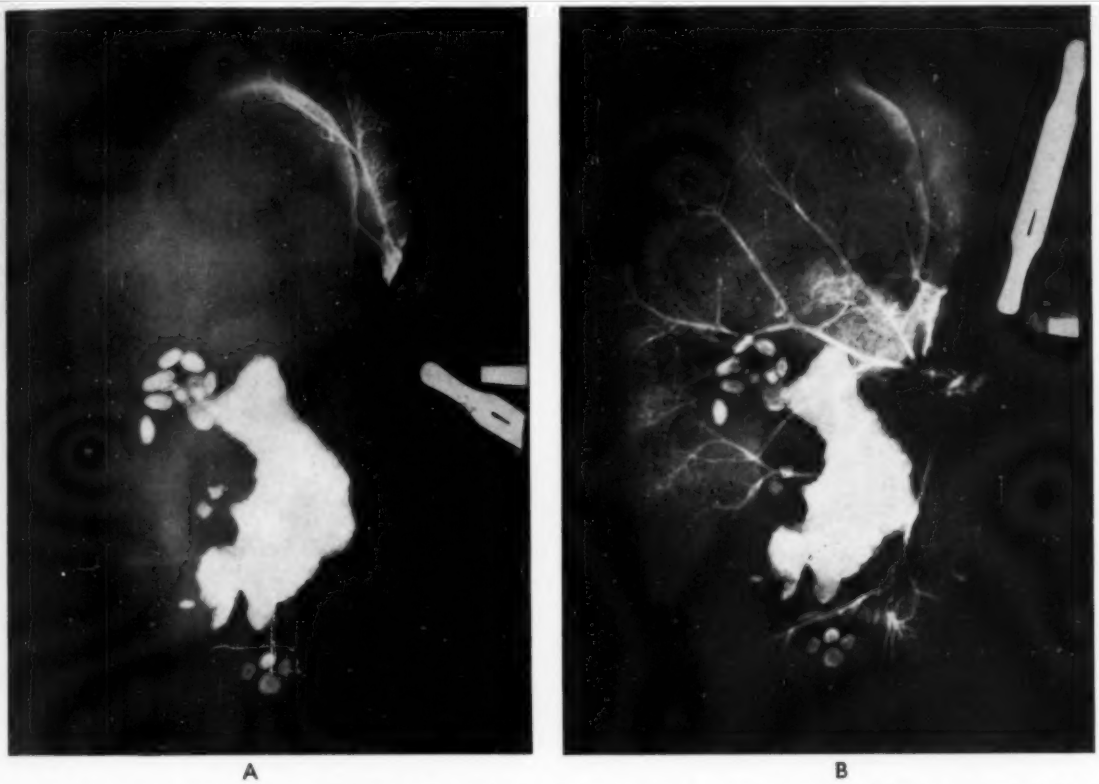
C

FIG. 750.—An arteriogram of an advanced case of carcinoma. The bulk of the tumour was at the upper pole, where there is no arterial filling. No 'pooling' is seen in the arterial phase (A), but it can be seen slightly in the early venous phase (B) and to a greater extent in the last film (C)

FIG. 751.—A cast of the pelvi-calicine system of the right kidney. The upper major calix contains and is almost completely filled by a stone which is embedded in the resin. The remainder of the calices are normal.

removed with sufficient length of pedicle to include all the origins of the segmental arteries from the main stem. It was necessary, therefore, in some cases to cannulate a divided vessel separately if it had been

accidentally damaged during the process of nephrectomy. The post-mortem specimens, however, always included part of the aorta. It was decided to include all degrees of calculous disease in the investigation, as early calculous lesions would be most interesting as regards change in the cortical vessels near the



A B

FIG. 752.—A, A radiograph of a kidney with a staghorn calculus. There are a number of oval, laminated stones in the middle and lower segments. An arteriogram has been made of the apical segment. B, An arteriogram of all the segments except the apical segment. Note the oval opacities which can be seen embedded in the lower part of the staghorn calculus.

lesion, whereas a calculous hydronephrosis would be of more value in assessing alteration of the pattern and calibre of the segmental arteries.

METHODS OF INVESTIGATION

The same methods and techniques were used as in the earlier experiments. Renal arteriograms were made first, and later a plastic cast was made of the arterial and calicine systems. In the latter case the stone became embedded in the resin, except where it was adherent to the wall of the calix, or lay in a space which had no communication with the pelvi-calicine system. Corrosion of the specimens by hydrochloric acid resulted in solution of the stone where this was not entirely surrounded and protected by the resin. After considerable experimentation it was found that satisfactory removal of the organic material could be obtained by boiling the specimen in 4 N. caustic soda, without damage to either the resin cast or the stone.

COMPOSITION AND FORMATION OF CALCULUS

Although this work has been concerned primarily with the study of the intrarenal arteries, observations have been made which provide some evidence as to the mode of formation of renal calculus.

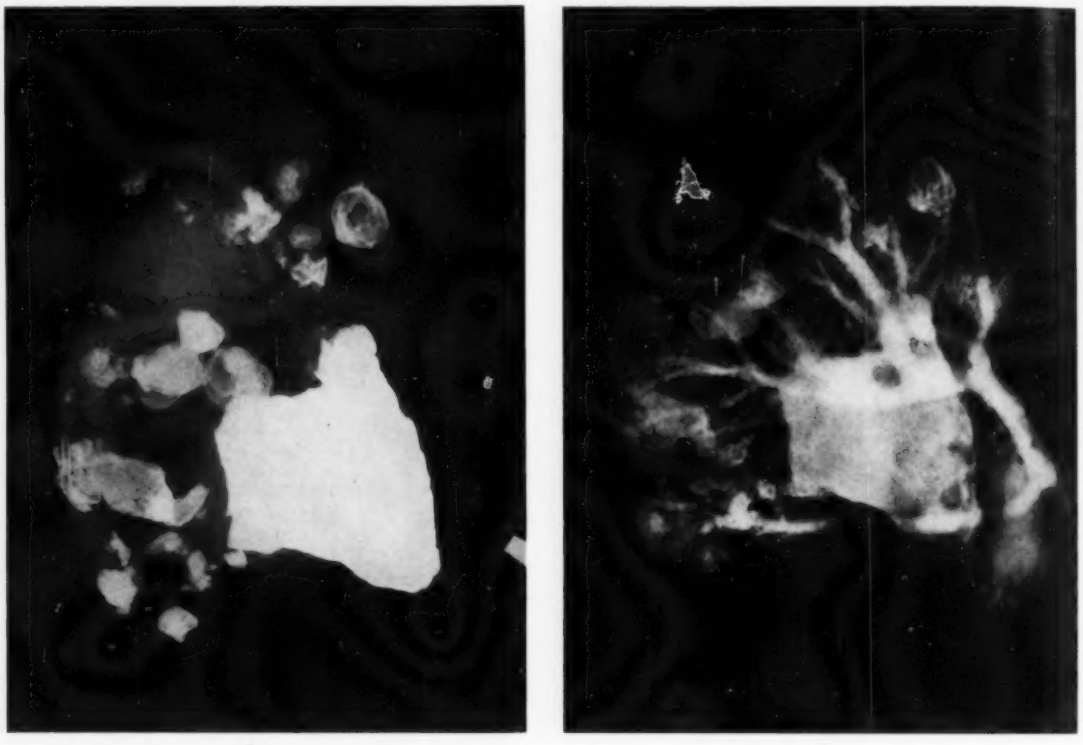
Most staghorn calculi lying in the pelvis of the kidney suggest by their shape that they have resulted from growth of a small stone which initially had been unable to enter the ureter because of its shape or size. Such a calculus in the course of time shows projections upon its surface at points opposite the mouths of the major calices, indicating that urinary deposits are laid down in the line of the current as silt forms on the islets of a delta.

A single stone occupying and taking the shape of a calix (*Fig.* 751) will never pass into the pelvis. Such a case would be suitable for partial nephrectomy, removing the stone and the diseased calix at the junction of the latter with its normal fellows. This stone, as do many others, shows the close adhesion of the stone to the wall of the calix. Such evidence as there is suggests that this adhesion is secondary, and not the primary attachment of the stone to the pyramid, as Randall (1937) described. It is more probable that a smaller calculus or concretion was extruded into the calicine lumen, but, being unable to pass to the pelvis, remained in the parent calix, where salts were deposited upon it until it had assumed the shape of the calix.

One specimen with a gross staghorn calculus was seen on radiography to contain a number of opacities in the middle and lower segments which lay outside the calicine system. These opacities differed entirely from the smooth continuous density of the intracalicine

stone in that they were composed of innumerable fine granules.

Fig. 752 shows a radiograph of a specimen illustrating an early phase in the development of calculus. A large stone is present in part of the pelvis and the lower major calix. In its substance can be seen a number of concretions which are oval in shape. In the region of the pyramids there are eighteen



A B

FIG. 753.—A, A radiograph of a kidney with a large stone in the pelvis. There are a number of smaller stones in the major and minor calices. The majority of the smaller stones lie near the periphery of the kidney. Note the pencillated and laminated opacity near the periphery of the middle segment. B, An arteriogram of the same kidney. There is no diminution in the size of the segmental arteries.

similar oval opacities lying in two main groups, the larger in the middle segment, the smaller in the lower segment. In contrast, most of the opacities embedded in the central calculus are in its lowest part. This was probably produced by gravity, for although the concretions had most likely arisen from the more prolific middle segment, they had fallen to the dependent calix and become embedded there. Even though these concretions are small they are laminated, their size varying from 3 to 6 mm. in their longest axis. Comparison of the cast of the pelvis and calices shows that some of these oval opacities were probably lying in the cortex, since only a few were embedded in the wall of the calicine cast.

A third specimen contained a large calculus, the bulk of which appeared to be homogeneous, but opposite the major calices were ring shadows similar to those described in the previous specimens. Their position suggested that further stones had been produced after the formation of the main calculus, and having been extruded from the parent calix they became embedded in the growing pelvic stone. That such calculi are constantly being formed is shown by the presence of innumerable small stones in the periphery of the kidney substance (*Fig.* 753 A), some being intracalicine and others extracalicine in position.

Examination of these and other specimens confirms some of the observations made by Carr (1954). Calculi have been found in the parenchyma of the kidney, lying outside the lumen of the calices. In some they consist of innumerable fine granules, packed closely together and being of approximately equal size; in others the collections were more loosely associated, the individual granules varying in size and shape and often being some distance from one another, the largest bodies lying near the calices, the smallest lying near the periphery of the kidney.

Some of these opacities were oval in shape, being of remarkable similarity even in different specimens. This shape and that of the pencillated body shown in *Fig.* 753 A, suggest, as does Carr (1954), that these minute calculi are formed in some tube or duct within the kidney substance, possibly in the lymphatic system. Although in one specimen the opacities were confined to two segments only, in many specimens they were distributed evenly throughout the kidney.

Recurrence of the calculus is not necessarily due to inadequate removal of the stone at the initial operation, but may be due to the continued formation of further calculi. This has been demonstrated not only by the combined presence of a staghorn calculus in the pelvis of the kidney and that of smaller stones in the parenchyma, but also by the fact that the pelvic stone contains in its substance those small oval calculi which have been extruded

from time to time into the calices. Similar evidence is shown in a specimen of a kidney from which a calculus had been removed some years previously. The lower pole now contained four groups of composite stones, in two of which the smaller granules lay near the periphery. Again, the central stone in the pelvis contained many smaller calculi.

THE SEGMENTAL ARTERIES IN CALCULOUS DISEASE

The Segmental Pattern.—There was remarkably little disturbance in the distribution and arrangement of the intrarenal arteries, the pattern being little different from that of the normal kidney. Even when hydronephrosis was present, with dilated calices containing calculi (*Fig.* 754), the segmental arteries were not displaced, and indeed the calicine dilatations appeared to have grown around them.

FIG. 754.—The anterior view of the cast of the same kidney as seen in *Fig.* 753. There are a number of calculi embedded in the resin. Note the normal segmental pattern of the arteries; their calibre is within normal limits.

Calibre of the Segmental Arteries.—In one specimen (*Fig.* 752 B) the calibre of the segmental arteries was reduced to approximately half the normal size. Apart from this one specimen the investigation showed little change in the calibre of the segmental arteries and their main branches. In calculous hydronephrosis the vessels were normal or slightly reduced in size.

The Arterial Pattern in the Cortex.—The pattern of the finer cortical vessels in the segments of the kidney showed considerable change compared with the normal. The cortical vessels, although discernible, were frail and lacked the definition seen in the films of normal kidneys. This lack of solidarity was most evident in the region where the stone was present, the finer vessels being elongated and tortuous, especially when the cortex was particularly avascular. The normal 'boutons' were seldom seen.

RENAL ARTERIOGRAPHY AT OPERATION

The line of incision into the kidney substance in partial nephrectomy will depend to a varying degree on the extent of the calicine disease and on the arrangement of the arteries in the area involved. Knowledge of the anatomy of the arteries in health and disease, as has been described, should be of guidance to the surgeon in the siting of his incision. Resection of the lower segment preceded by ligation

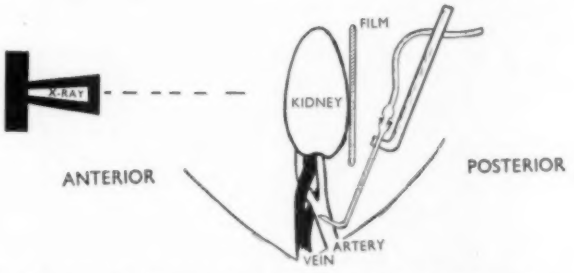


FIG. 755.—A diagram showing the method of renal arteriography at the time of operation upon the kidney.

of the segmental artery presents little difficulty. In those cases where an additional subsegment is to be removed, or, as in resection of the upper pole of the kidney, involving removal of the apical and part of the upper and posterior segments, necessitating

FIG. 756.—The needles devised by the writer for injection of diodone into the renal artery at the time of operation upon the kidney.

division of arteries within the kidney substance, it would be of value to have additional information as to the exact course of the arteries and their relation to the stone in a particular kidney.

Translumbar aortography does not always outline the renal vessels, since the site of puncture may not be opposite or near the mouth of the renal artery. In addition the renal arteries are not always outlined

with adequate definition, this being due to respiratory movement, the contents of the abdomen, and interposition of soft tissues. In order to produce a renal arteriogram at the time of operation which would be

FIG. 757.—An arteriogram of the right kidney obtained by the technique described.

of comparable value to those produced in these investigations, the following technique was evolved.

Technique.—The patient is anæsthetized and placed upon the operating table in the lateral position. An oblique incision is made over and parallel to the 12th rib. It is best to resect the 12th rib unless the patient has a wide renal angle, since adequate exposure is essential. The kidney is mobilized and the renal artery defined. It is important that this definition be complete, so that the segmental arteries having a precocious origin from the main stem will be noted. In practice it is found that when the posterior division is large it may obscure the anterior division lying in front of it and be mistaken for it, so that an injection into this will give only a segmental arteriogram of the posterior segment. A sterile, waterproof pouch, approximately 5 in. long and 3 in. deep, is loaded with double-wrapped X-ray film, which is then placed in the wound behind the kidney. As the plastic pouch and film are pliable they are easily moulded around the kidney when this is necessary. An injection of 70 per cent diodone is then made into the posterior aspect (*Fig.* 755) of the renal artery. As the site of the injection is frequently in the depth of the wound, where there is little room for manipulation, I devised the needles shown in *Fig.* 756, the handle and right-angle bend of which enable the injection to be made in a few seconds with the minimum amount of disturbance to the kidney or the film.

The first arteriogram made in this manner was carried out on a cadaver with a satisfactory result. Since then five arteriograms have been made at the time of operation (*Fig.* 757), usually preceding nephrectomy. In one instance a segmental arteriogram was made successfully.

This technique is still in its infancy, but I believe that it is worthy of further development.

There are many Surgeons and Pathologists who have provided me with the specimens necessary for this work. Unfortunately, it is not possible to thank them all publicly.

I am deeply grateful to Sir Cecil Wakeley, Bt., not only for his constant encouragement and interest, but also for his kindly help in overcoming many problems.

Much of the early work was done in the Department of Professor R. S. Pilcher, and indeed without his help and advice the work would not have been started.

BIBLIOGRAPHY

BRODEL, M. (1901), *Bull. Johns Hopk. Hosp.*, **12**, 13.
CARR, R. J. (1954), *Brit. J. Urol.*, **26**, 105.
FELIX, W. (1912), *Human Embryology* (ed. Keibel and Mall), **2**, *Fig.* 572 and p. 822. Philadelphia: Lippincott.
GRAVES, F. T. (1954), *Brit. J. Surg.*, **42**, 132.
HUNTER, J. (1794), *Inflammation and Gun Shot Wounds*, 184. London: G. Nicol.
PALMER, J. F. (1835), *Collected Works of John Hunter*, **1**, 32. London: Richard Taylor.
RANDALL, A. (1937), *Ann. Surg.*, **105**, 1022.
REAGAN, G. W., and CARROLL, G. (1951), *J. Urol.*, **66**, 467.
STEWART, H. HAMILTON (1952), *Ann. R. Coll. Surg. Engl.*, **11**, 37.
WALSH, A. (1951), *Brit. J. Urol.*, **23**, 377.
WHITESIDE, C. G. (1953), *Modern Trends in Urology* (ed. Riches), 33. London: Butterworth.

A CLINICO-PATHOLOGICAL STUDY OF THYROID CARCINOMA

By ROBERT ALHADEFF, FOSTER SCOTT*, and SELWYN TAYLOR

DEPARTMENTS OF SURGERY AND PATHOLOGY, POSTGRADUATE MEDICAL SCHOOL, LONDON

MALIGNANT disease of the thyroid gland is often unsuspected (Beal, Scholnick, and Stevens, 1952) and may elude diagnosis even in expert hands (Pemberton, 1938; Troell, 1946; Rankin and Donald, 1933; Tinker, 1934; Coffey, Amoroso, and Mazzara, 1950; Fisher and Fisher, 1951; Cerise, Randall, and Ochsner, 1952; Majarakis, Slaughter, and Cole, 1953). It is sometimes bizarre in its biological behaviour (Duncan, Cantril, and Lund, 1952) and may follow an unpredictable course. In addition the histological picture may make the diagnosis of malignancy doubtful (Dunhill, 1931) and classification difficult (Perloff and Schneeberg, 1951).

Table I.—CLASSIFICATION OF 67 THYROID CARCINOMAS

Differentiated carcinoma (45)	Follicular (31)	Grade I (19)
		Grade II (12)
	Papillary (14)	Grade I (11)
		Grade II (3)
Undifferentiated (anaplastic) carcinoma (18)	Small-cell (13)	
	Giant-cell (5)	
Miscellaneous (4)	Squamous (2)	
	Non-encapsulated sclerosing (1)	
	Unclassified (1)	

In an attempt to correlate the clinical course with the pathological findings, 67 patients with thyroid cancer admitted to Hammersmith Hospital during the period 1947–54 have been reviewed. Of these, 18 patients had previously undergone operation elsewhere before being referred for further treatment.

The majority of patients came from non-goitrous districts, although it is likely that some may have spent part of their lives in areas of endemic goitre. A histological examination of all tumours was made. The classification adopted was that of Warren and Meissner (1953) but it was found desirable to modify their groups as described below. *Table I* summarizes the types of tumours encountered.

INCIDENCE

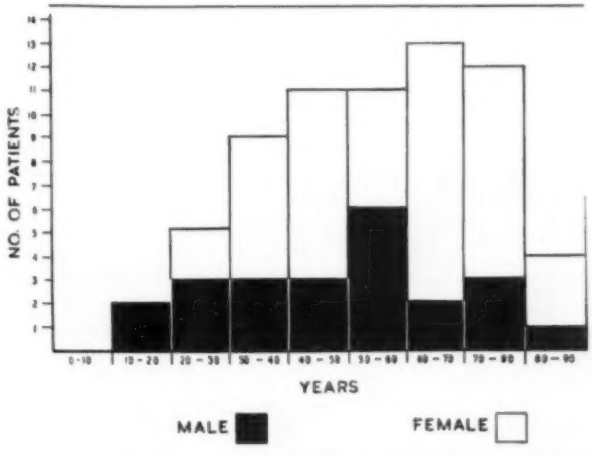
The number of patients presenting with thyroid malignancy steadily increased with age, reaching a peak in the 60–70 year group (*Table II*). The oldest patient in this series was 87 and the youngest 15, and it was noteworthy that nearly one-quarter of the total were under 40 years of age. In recent years attention has been drawn to the fact that thyroid cancer is not uncommon in the young. Duffy and Fitzgerald (1950), for example, described 28 patients under the age of 18 whom they treated for this disease at the Memorial Hospital, New York. Hare (1937) and Kennedy (1935) recorded 14 under the age of 15 and Horn and Ravdin (1951) 22 patients under 26 years of age.

The sex incidence in our series averaged nearly two females to one male (1·9 : 1) which is strikingly similar to Pemberton's (1938) ratio of 1·7 : 1 at the Mayo Clinic. It is important to note, however, that up to the age of 40 exactly the same number of cancers occurred in both sexes (*Table II*), while after this the female : male ratio was 2·4 : 1. The overall female preponderance in this series was due therefore to the increase in the number of thyroid cancers occurring in women over the age of 40.

On histological survey, the three types of tumour : follicular, anaplastic, and papillary, occurred in that order of frequency. Three distinct curves (*Table III*) were obtained when the incidence of these cancers was plotted against age. The follicular carcinomas showed two peaks of incidence, one in the 30–40 and the other in the 60–70 age groups. The papillary cancers were evenly distributed throughout all age groups, while the anaplastic tumours were only encountered after the age of 40.

The sex ratio of 1·9 : 1 did not alter appreciably with the follicular and papillary tumours, but in the case of the anaplastic growths the female : male ratio rose to 3·5 : 1.

Table II.—AGE AND SEX INCIDENCE OF THYROID CARCINOMAS



In summary one may say that in the present series papillary carcinomas were more frequent in patients under 30, the follicular types predominated in the 30–40 age group, while in the fifth decade the three groups of tumours appeared with equal frequency (*Table III*).

RELATIONSHIP TO SIMPLE GOITRE

Of the present series of 67 patients with thyroid malignancy, 20 (30 per cent) had previously had a goitre (*Table IV*), a 'previous goitre' being defined as a symptomless thyroid swelling present for at least ten years. The average duration of these goitres was actually 17 years. Malignancy occurring

* Fellow, National Research Council of Canada.

in a long-standing goitre was nearly three times more often follicular than anaplastic in type. In this group, the ratio of females : males was 3 : 1 and reflected the higher incidence of goitre in women. Of the remaining 70 per cent of patients with thyroid cancer who did not have a 'previous goitre', the female : male ratio was 1·5 : 1.

Follicular carcinoma arose with approximately equal frequency whether a previous goitre had been present or not and the average duration of a previous goitre in this group was 16 years.

In the papillary group 4 patients gave a history of a previous thyroid enlargement, but in each case this had been present for less than ten years. Taking into account the slow progress of papillary thyroid carcinoma, it is possible that in this particular group the goitre had been malignant from the start. Only one-quarter of the anaplastic (i.e., highly malignant) carcinomas arose from previously goitrous glands. The average duration of the goitre in this category was 15 years.

It has often been reported that malignant change in a solitary nodule is more common than in a multinodular goitre (Cope, Dobyns, Hamlin, and Hopkirk, 1949; Cole, Majarakis, and Slaughter, 1949; Lahey and Hare, 1951; Cole, Slaughter, and Rossiter, 1945; Crile and Dempsey, 1949; Taylor, 1951) and in some clinics the incidence of malignancy in the solitary non-toxic nodules excised has been as high as 20 per cent. Only 1 per cent of toxic nodular goitres have been reported malignant (Cole, Slaughter, and Majarakis, 1949). We have not attempted to determine the incidence of malignancy in solitary thyroid nodules because nodules which appeared solitary on clinical examination were frequently found to be multiple at operation.

In the United States 10 per cent of the multinodular goitres excised were found to be malignant (Cope and others, 1949; Cole and others, 1949; Crile and Dempsey, 1949). These figures, however, only reflect the policy adopted by individual surgeons or clinics since, as Crile (1949) rightly stresses, only a small fraction of non-toxic nodular goitres are excised.

Table III.—Age Incidence of the Three Main Types of Tumour

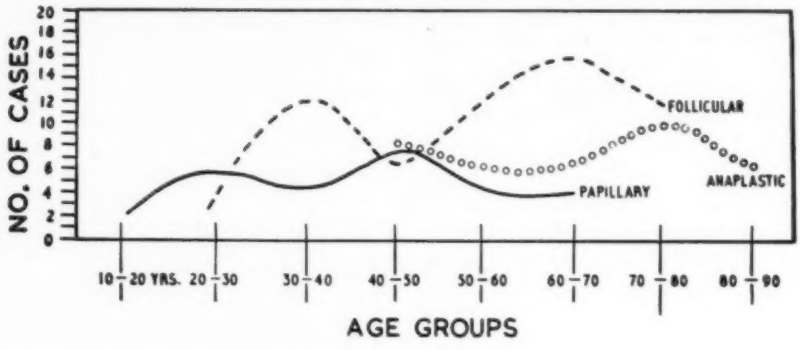


Table IV.—Relationship between Simple Goitre and Thyroid Carcinoma

Tumours	Total No. of Cases	'Previous Goitre'	♀	♂	Percentage with 'Previous Goitre'	Average Duration (Years)
Follicular	31	13	10	3	42	16
Papillary	14					
Anaplastic	18	5	4	1	28	15
Sclerosing	1					
Squamous	2	1	1			32
Unclassified	1	1		1		40
Total	67	20	15	5	30	17

A 'previous goitre' is here defined as a "symptomless thyroid swelling present for at least ten years."

Table V.—First Symptoms and Incidence

First Symptom	*No. of Cases*
Swelling in the neck or increase in size of previous goitre	43
Symptoms from secondaries	9
Voice change	4
Dyspnœa	4
Dysphagia	2
Weight loss	2
Toxicity	3
Total	67

CLINICAL FEATURES

It has been stated that an early diagnosis of thyroid cancer is often made on suspicion rather than certainty owing to the lack of reliable symptoms and signs.

The first symptom noticed in most instances in our series was a swelling in the neck (*Table V*), but 24 patients were unaware of any thyroid abnormality at the beginning of their illness. Of these, 9 complained of symptoms referable to distant metastases, while most of the others suffered from mild pressure symptoms which led them to seek medical advice. Pressure symptoms were complained of more commonly by those patients who had the less differentiated tumours. A history of previous goitre was elicited from nearly half the patients with Grade I follicular carcinoma and from one-third of the patients with Grade II carcinomas.

Table VI.—Presenting Signs and Symptoms on Admission

Symptomatology	Follicular			Papillary			Anaplastic	Squamous	Sclerosing	Unclassified	Combined Totals
	I	II	Total	I	II	Total					
Number of cases	19	12	31	11	3	14	18	2	1	1	67
Average duration of symptoms (months)	22	10	16	25	7	16	5	3	1	4	7·5
Recent thyroid enlargement	12	9	21	7	3	10	16	2	1	1	51
Symptoms from secondaries	6	3	9								9
Huskiness	2	4	6				8				14
Dyspnœa	4	4	8				6	1			15
Dysphagia		2	2				4				6
Toxicity	2	1	3				1				4
Weight loss	1	1	2				2	1			5
Pain referred behind ear							6				6
Clinical Evidence of Malignancy											
Local spread	7	4	11	5	3	8	15	1	1	1	37
Regional spread	11	4	15	5	2	7	10				32
Distant spread	13	3	16	2	1	3	9	1			29

Table VI shows all the symptoms complained of by the time medical advice was sought. The appearance of new symptoms and the accentuation of the initial ones brought the patients for treatment in most instances.

In the present series the average duration of symptoms for all groups of cancer before the patient was seen at hospital was seven and a half months. Patients with follicular and papillary tumours had symptoms for an average of sixteen months. Grade II tumours were seen earlier than Grade I and all others sought advice within five months.

Recent thyroid enlargement was noted by three-quarters of our patients. However, it must be remembered that the same complaint is made by more than half of those with non-malignant nodular goitre (Majarakis and others, 1953).

Follicular Carcinoma.—Patients with these tumours were the only ones who first complained of symptoms due to distant metastases. Nine out of 31 presented in this manner and although biopsy of the metastases showed them to be of thyroid origin, 2 patients had thyroids which were normal on palpation. The more differentiated follicular tumours (Grade I) were more prone to give rise to this clinical picture than the less differentiated (Grade II).

One-third of follicular carcinomas were soft on palpation. Nearly one-third had evidence of local spread and half presented with regional lymph-node involvement and distant metastases.

When the tumours were graded histologically it was seen that both regional and distant metastases were found more frequently in those patients with well-differentiated tumours. This unusual behaviour was typical of follicular thyroid carcinoma.

Papillary Carcinoma.—Pressure symptoms were not complained of by patients with these tumours; only one had a unilateral recurrent nerve palsy and another a Horner's syndrome.

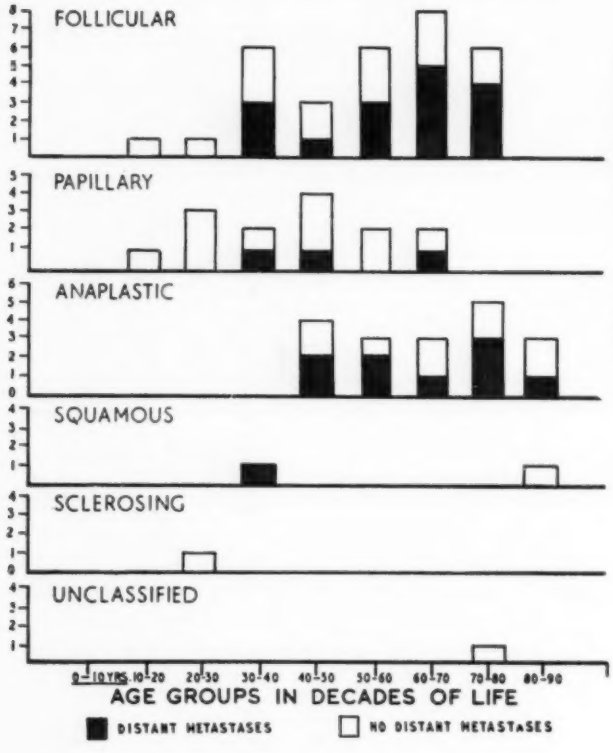
The commonest lesion was an apparently solitary nodule in the thyroid. Multiple nodules were felt in some patients' thyroids and one had a smooth firm enlargement of the whole gland. With the exception of three tumours, all were either firm or hard. When first seen, half of the patients had involvement of the regional lymph-nodes and clinical evidence of fixation of the primary growth.

Distant metastases were present in 3 of the 14 patients. When the papillary carcinomas were graded histologically it was apparent, even from this limited series, that good clinico-pathological correlation could be established.

Anaplastic Carcinoma.—There was no difficulty in diagnosing these tumours. They were hard, fixed, bulky, and usually associated with

severe pressure symptoms of recent onset. One-third of these patients presented with unilateral vocal cord paralysis. Pain radiating behind the ear was also complained of by a third of these patients and this symptom was interesting, since it denoted infiltration of the strap muscles (cervical nerves 2 and 3). The pain was referred to the area of distribution of the lesser occipital nerve.

Table VII.—Age Incidence of Distant Metastases



Regional and distant metastases were already present in half of the patients. The two squamous carcinomas encountered were indistinguishable clinically from anaplastic tumours; one had already spread locally and the other distally when first seen.

DISTANT METASTASES

Taken as a whole, thyroid carcinoma was seen to metastasize with equal frequency on the one hand to bones and on the other to mediastinum and lungs. When the various types of tumour were considered separately it became evident that follicular cancers metastasized twice as frequently to the skeleton, while the anaplastic cancers metastasized twice as frequently to the lungs. The papillary tumours were not seen to give rise to bone deposits.

In 8 patients metastases were already multiple and widespread. Of these, 7 had follicular primaries and one an anaplastic tumour.

The incidence of distant metastases was investigated in the various histological groups in relation to the patients' age (*Table VII*). It was noticed that distant metastases did not occur in the first three decades of life. After the age of thirty a proportion of patients from each tumour group developed distant metastases, but this proportion did not alter significantly at different ages.

The distribution of metastases from the three main groups of tumours is shown in *Fig.* 758. The frequency of metastases to the skin of the chest wall is surprising.

OCCURRENCE OF HYPERTHYROIDISM

It is a rare occurrence to find a patient with thyroid cancer exhibiting features of hyperthyroidism. However, 4 were encountered in this series. Toxicity superimposed on thyroid malignancy may be due to coincidental hyperfunction of the non-neoplastic part of the gland, to activity of the cancer in the gland, or more commonly to metastatic thyroid tissue that maintains its biological properties.

Hyperfunctioning thyroid cancer *per se* must be a very rare occurrence indeed. Nevertheless one patient was seen who had been suffering for ten years from a toxic nodular goitre for which thiouracil had been prescribed. When thyroidectomy was performed a Grade I follicular carcinoma was found.

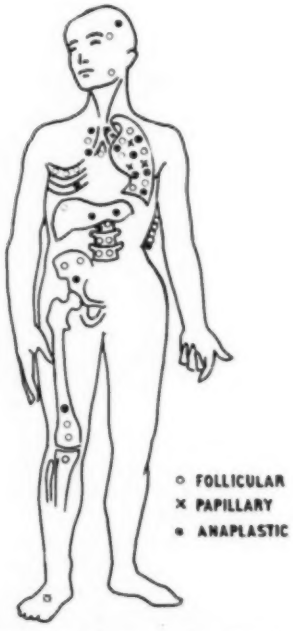
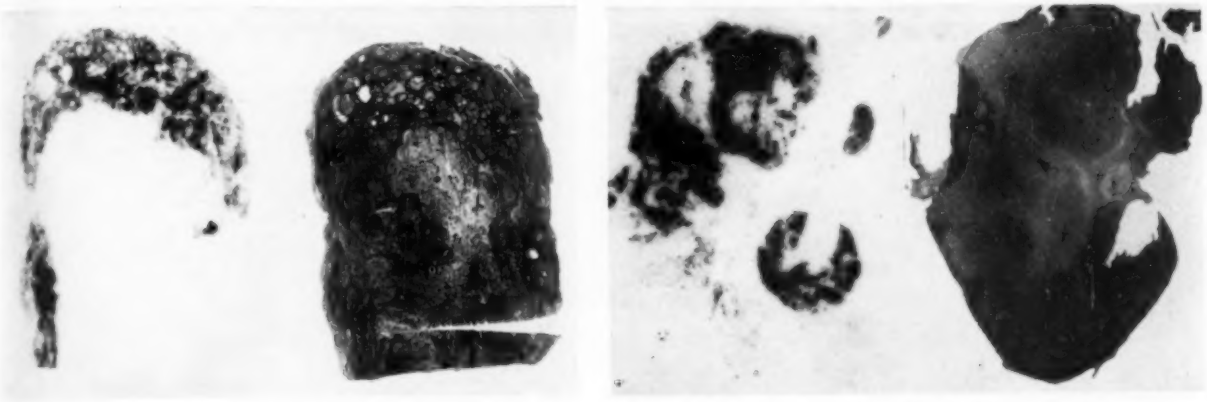


Fig. 758.—Distribution of metastases of thyroid carcinoma in 29 patients.

Excision of this unquestionably malignant tumour relieved her of all toxic symptoms.

Clinical evidence of hyperthyroidism was present in only 3 other patients. It was confirmed by radio-iodine excretion studies and tracer techniques were used to compare the iodine-concentrating capacity of the primary tumour with the metastases. In addition, autoradiographs were prepared (*Fig.* 759) to confirm the metabolism by the actual tumour tissue. Two of these patients, one with a Grade I and another with a Grade II follicular carcinoma, showed easily detectable radio-iodine uptake by the metastases but no functional activity in the neck tumours. Hyperthyroidism was caused by the

sheer bulk of functioning metastatic thyroid tissue. Paradoxically, a patient with a small-cell diffuse carcinoma initially presented with some features of hyperthyroidism, but when the metastases were examined they showed the same anaplasia found in localized carcinoma in a follicular adenoma'. Similarly, we prefer the term *Grade I papillary carcinoma* to 'low-grade localized carcinoma in a papillary adenoma'. Warren and Meissner's practice of dividing undifferentiated small-cell carcinomas



A B

FIG. 759.—Autoradiographs and corresponding histological preparations. A, Papillary carcinoma showing absence of iodine uptake (× 2·3). B, Metastases of follicular carcinoma in lymph-node showing iodine uptake after total thyroidectomy.

the primary tumour. Activity was likewise detected in the metastases of a papillary Grade I tumour, and was sufficiently induced in a few others to warrant treatment with radio-iodine in therapeutic doses.

Although the Grade I follicular carcinomas of this series were unquestionably the ones with the greatest capacity to concentrate iodine, there was in addition

Table VIII.—CLASSIFICATION OF MALIGNANT DISEASE OF THE THYROID GLAND

(*Modified from Warren and Meissner*)

DIFFERENTIATED CARCINOMA

Follicular carcinoma	Papillary carcinoma
↓	↓
Grade I	Grade I
Grade II	Grade II

UNDIFFERENTIATED CARCINOMA

Small-cell carcinoma — Giant-cell carcinoma

MISCELLANEOUS

Squamous carcinoma
Non-encapsulated sclerosing tumour
Hurthle-cell carcinoma
Lymphoma
Sarcoma

a very small number of cases where functional activity bore little relation to the histological pattern. It appears therefore that the rule that function of a thyroid carcinoma is linked with orderly cell arrangement and the presence of colloid is not universally applicable.

PATHOLOGY

The classification adopted was that of Warren and Meissner (1953) with three slight modifications (*Table VIII*). It is not certain that all follicular carcinomas of even low-grade malignancy arise from follicular adenomas, therefore the term *Grade I follicular carcinoma* has been substituted for Warren and Meissner's group of tumours called 'low-grade

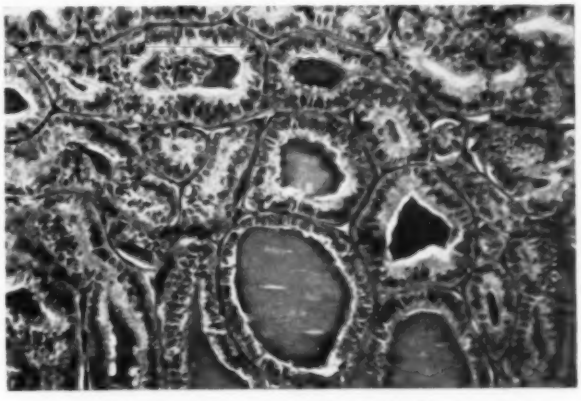


FIG. 760.—Follicular carcinoma Grade I. (× 105.)

into compact and diffuse types has not been followed because of the intimate admixture of the two forms and also because we have found no significant clinical differences associated with these two patterns.

Differentiated Carcinoma.—

a. Grade I Follicular Carcinoma.—Most of these tumours were solitary, stoutly encapsulated, and of firm consistence. The size was variable but 75 per cent were over 5 cm. in diameter. The cut surface usually had the sheen of colloid-containing tissue, but occasionally degeneration, including cyst formation, old and recent hæmorrhage, calcification, and fibrosis, was present. Most of the Grade I follicular carcinomas presented no gross evidence of malignancy, and were in most cases indistinguishable from adenomas. Microscopically (*Fig.* 760) these tumours were composed of closely packed colloid-containing follicles. The follicles were of uniform size, but showed slight distortion. The cells were cuboidal or columnar in shape, showed little pleomorphism or hyperchromatism and few mitoses.

There were three variations of the above pattern. The most common was an alveolar or solid follicular

form (*Fig.* 761), the solid alveoli being easily defined with a reticulin stain (*Fig.* 762). A less common pattern was trabecular, possibly derived from compression and elongation of developing follicles; the structure here was similar to that seen in 'embryonal' adenomas. The third variant showed fields similar to a 'fœtal' adenoma where small follicles, with or without colloid, were scattered throughout an œdematous eosinophilic stroma. Often these different patterns were seen in the same tumour, but the well-defined follicular form usually predominated.

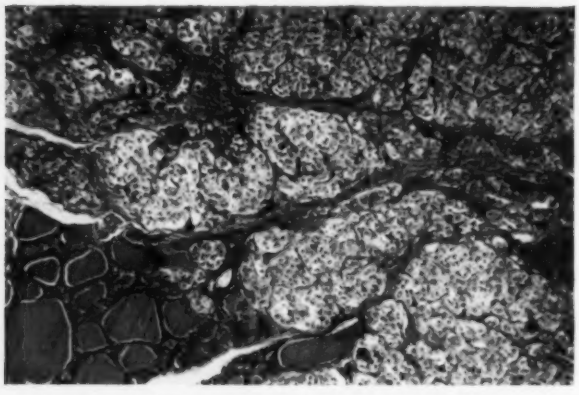


FIG. 761.—Follicular carcinoma Grade I, showing solid alveoli. (× 60.)

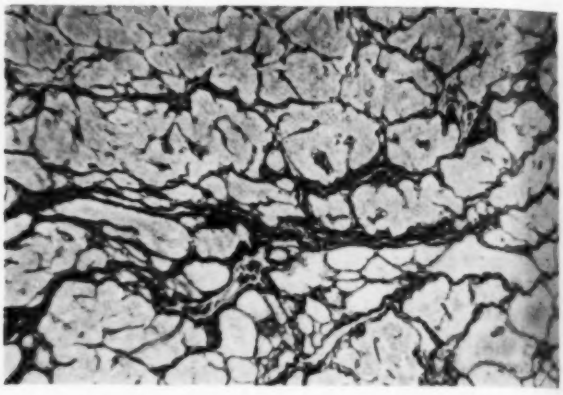


FIG. 762.—Same as *Fig.* 761. Reticulin stain.

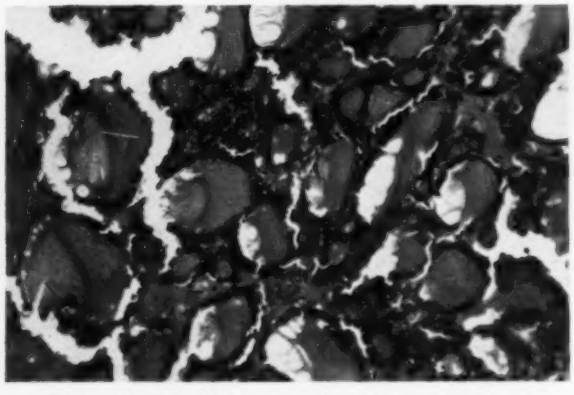


FIG. 763.—Deposit in a rib of a 'benign metastasizing goitre.' The histological picture is that of normal thyroid tissue. (× 105.)

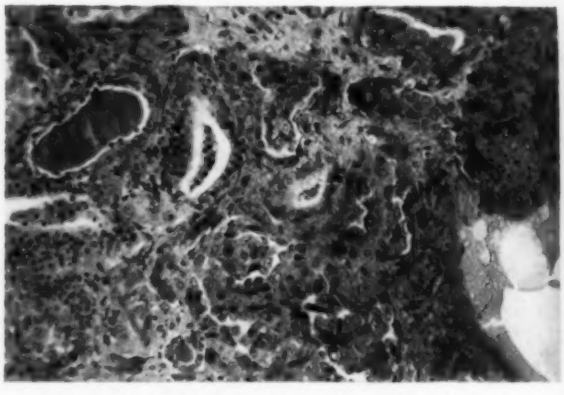


FIG. 764.—Follicular carcinoma Grade II. (× 105.)

These tumours were at first sight indistinguishable from follicular adenomas and it was only by the finding of invasion of the capsule, lymphatic vessels, or blood-vessels or by the presence of metastases, that a diagnosis of malignancy could be made. According to Warren and Meissner (1953) the invasion of blood-vessels rather than lymphatic vessels or capsule is more likely in follicular tumours, but in our series capsular invasion was commonest. Such capsular invasion is often difficult to distinguish from a fibrosed area traversing an adenoma, which superficially it may resemble. Lymph-vessel invasion is best seen just beneath the capsule, while blood-vessel invasion can be found anywhere in the tumour or capsule.

In this series 2 patients showed deposits in distant parts of the body of histologically normal thyroid tissue (*Fig.* 763) and no clinical evidence of a primary thyroid tumour. This condition which has been called 'benign metastasizing goitre' usually shows a Grade I follicular carcinoma on careful microscopical examination of the thyroid. In the two examples we encountered, one thyroid gland had been partially destroyed by radio-iodine and the other gland was only partially resected before radio-iodine was given; in neither could the thyroid carcinoma, which must have been present, be diagnosed with certainty.

b. Grade II Follicular Carcinoma.—These tumours, like the Grade I type, were usually solitary, but only partially encapsulated. They were soft more often than hard, owing to areas of necrosis, but other degenerative changes were uncommon. The infiltration described by Warren and Meissner (1953) in this type of tumour was not striking in our series and many of them were mistaken for adenomas before histological examination.

Microscopically, these tumours showed the general characteristics of a Grade I follicular carcinoma but there was poorer differentiation (*Fig.* 764). The follicles were more distorted and typically contained less colloid. Alveolar and trabecular areas were common. The cells, which were usually cuboidal in shape, often showed pleomorphism and hyperchromatism. Mitoses were plentiful. Invasion, which could easily be demonstrated, was not the only

criterion of malignancy in these tumours, since the distorted pattern and bizarre cell morphology alone were enough to distinguish them from follicular adenomas.

c. Grade I Papillary Carcinoma.—These were typically single, fairly well encapsulated, and, like the Grade I follicular type, over 5 cm. in diameter.

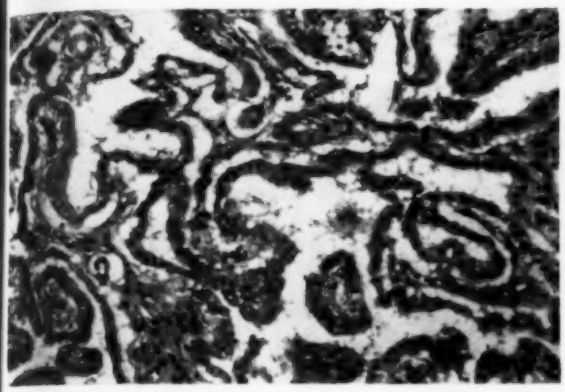


FIG. 765.—Papillary carcinoma Grade I. (× 105.)

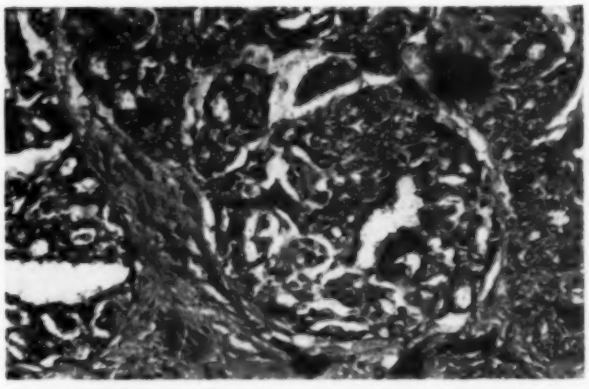


FIG. 766.—Papillary carcinoma Grade II. (× 105.)

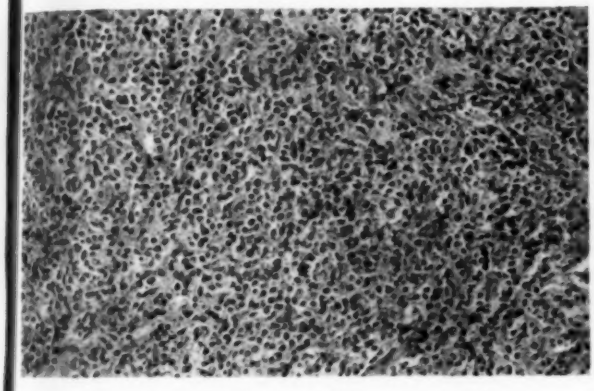


FIG. 767.—Small-cell carcinoma. (× 105.)

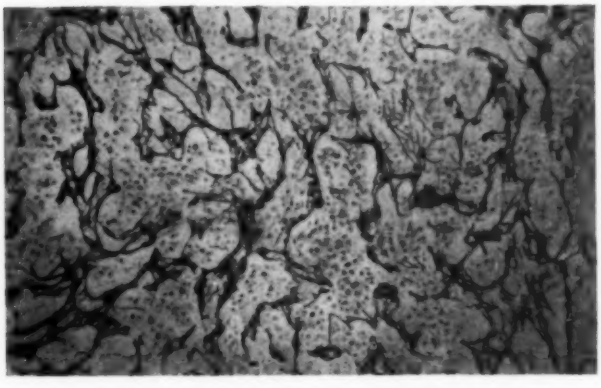


FIG. 768.—Same as *Fig.* 767. Reticulin stain.

The cut surface sometimes showed innumerable small cysts and these were associated with a rubbery consistence of the tumour.

Microscopically, the Grade I papillary carcinomas were composed of a single layer of cuboidal or columnar cells arranged on vascular connective-tissue stalks forming papillary processes (*Fig.* 765). These processes projected into small or large cystic spaces, some of which contained a pale eosinophilic substance resembling colloid. In other areas the tumour was so compressed that the papillary pattern was obscured and a picture resembling the trabecular form of the follicular carcinoma developed. It was rarely necessary, however, to use basement membrane stains in order to confirm the papillary structure. As in the Grade I follicular carcinoma, the cells were regular, with no evidence of dedifferentiation, and invasion of lymphatic vessels, blood-vessels, or capsule was the criterion of malignancy. Pure Grade I papillary tumours were uncommon; most of them showed varying degrees of follicular elements.

d. Grade II Papillary Carcinoma.—There were only tumours of this group in our series and they were all hard, solitary nodules between 2·5 and 5 cm. in diameter.

Microscopically the Grade II papillary tumours showed a papillary structure, but the cells lining the connective-tissue stalks were often multilayered (*Fig.* 766). Compressed papillary areas resembling a trabecular pattern were common. Pleomorphism and hyperchromatism were prominent, but mitoses were not common. These appearances were sufficient for a diagnosis of malignancy, but invasion could easily be found.

Many of the differentiated thyroid carcinomas presented a mixed picture, papillary and follicular patterns being found together. In these cases the tumour was classified according to the predominant element or according to the pattern showing the greatest cellular pleomorphism or most invasive properties.

Degeneration was a common finding in both types of differentiated carcinoma, but was more common in the papillary types and in the slow-growing tumours. Calcification, which may give the tumour a rock-hard consistence, usually took the form of small round granules which microscopically resembled psammoma bodies. Frank necrosis was rather uncommon in the differentiated carcinomas.

Undifferentiated Carcinoma.—

a. Small-cell Carcinoma.—In contrast to the differentiated thyroid carcinomas the small-cell carcinomas were single nodules in only 5 per cent

of cases. Despite rather extensive necrosis these tumours usually retained enough viable tissue to give them a hard consistence. The cut surface showed non-encapsulated firm grey-white tissue often invading adjacent structures. Most of these tumours were over 7·5 cm. in diameter.

Microscopical examination showed the cells to be arranged either in strands or clumps surrounded

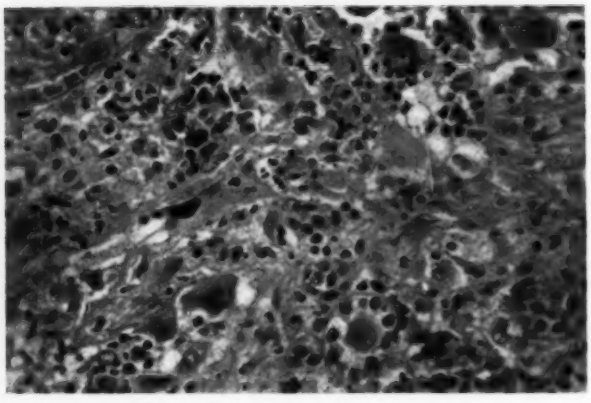


FIG. 769.—Giant-cell carcinoma. (× 222.)

by connective tissue, or in diffuse fields resembling lymphomas (*Fig.* 767). In the latter cases a reticulin stain helped to demonstrate the epithelial nature of these tumours (*Fig.* 768). The cells were either round or spindle-shaped, mitoses were present, but pleomorphism was absent. Often no thyroid capsule could be found and usually the cells were seen invading the strap muscles. Blood-vessel invasion was usually seen, but the lymphatic vessels in most fields were obliterated.

b. Giant-cell Carcinoma.—The giant-cell undifferentiated thyroid carcinoma could not be distinguished macroscopically from the small-cell undifferentiated types. Microscopically, no pattern was present and differentiation from a sarcoma was often difficult. The cells were either round or spindle-shaped and showed extreme pleomorphism and numerous mitoses (*Fig.* 769). Single or multinuclear giant cells were scattered individually or in clumps throughout the field in varying numbers.

Miscellaneous Tumours.—The miscellaneous group of malignant tumours contained two squamous-cell carcinomas and one non-encapsulated sclerosing tumour.

Squamous carcinomas of the thyroid are presumed to arise from either remnants of the thyroglossal duct or from squamous metaplasia of glandular epithelium. One of the squamous carcinomas in this series, a well-differentiated one, was found in association with a Grade II papillary adenocarcinoma. No area of benign squamous metaplasia from which the carcinoma might have developed could be found. The other squamous tumour was relatively undifferentiated.

One example of a non-encapsulated sclerosing tumour was encountered. This tumour was a greyish nodule, 0·5 cm. in diameter, and was discovered accidentally. Microscopically it showed small follicles containing colloid set in a fibrosed stroma. There was no invasion of blood or lymphatic vessels and there is doubt in our minds whether one should classify as malignant this particular type of tumour when it shows no invasive tendencies.

DIAGNOSIS

A correct pre-operative diagnosis of thyroid malignancy was made in 63 per cent of patients in this series.

Table IX.—TREATMENT EMPLOYED IN THIS SERIES

TREATMENT	FOLLICULAR		PAPILLARY		ANAPLASTIC		OTHERS	TOTAL
	I	II	I	II	Small Cell	Giant Cell		
Number of cases	19	12	11	3	13	5	4	67
Subtotal thyroidectomy or hemithyroidectomy	13	8	10	3	8	3	1	46
Total thyroidectomy	2	2	1		1	1		7
D.X.R.T.	11	7	5	2	9	5	3	42
I^{131} therapeutic or ablation dose	7	1	2	1				11
Tracheostomy	3	2			4	2		11
Local excision of nodes	6	2	4	1				13
Block dissection of neck	1		2	1				4

The anaplastic tumours were diagnosed correctly in almost all instances, the rapidity of their growth, often accompanied by alarming pressure symptoms, leaving no doubt as to their nature.

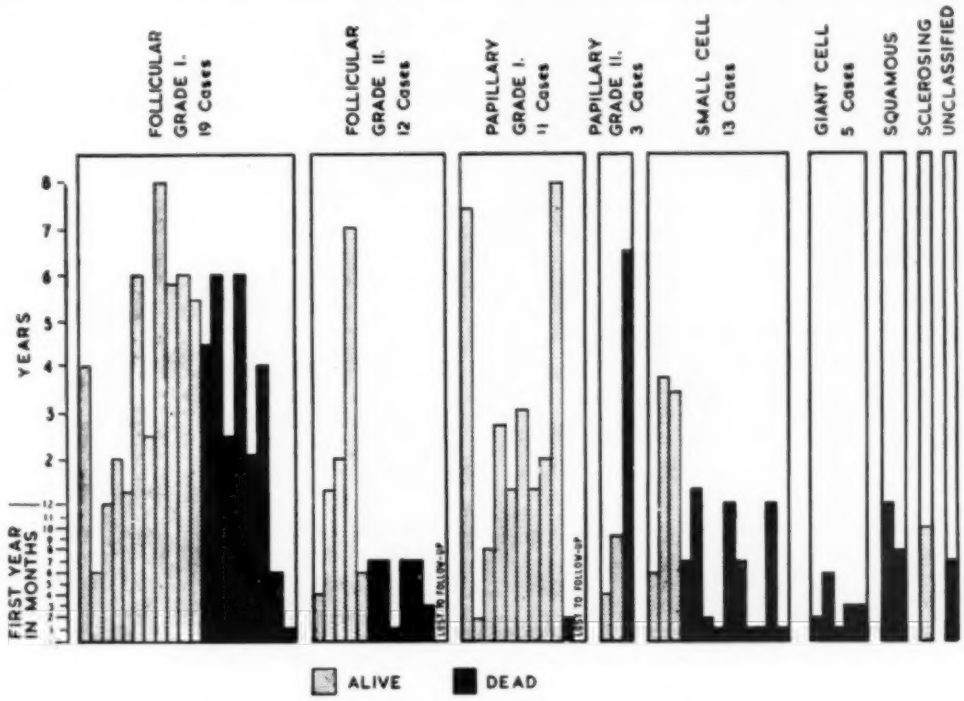
The papillary carcinomas were diagnosed clinically more easily than follicular growths. The papillary carcinomas were not associated with long-standing thyroid enlargement, but presented as swellings of recent onset and progressive growth. Nearly half of the follicular tumours presented as long-standing goitres that had recently enlarged.

Cancer of the thyroid in its earliest stages could not be differentiated clinically from a benign lesion; malignancy was first suspected when there was

localized enlargement of recent onset, either in a normal or previously enlarged gland. The consistence of the tumour was at times misleading, being soft or fluctuant in nearly 20 per cent.

When the disease was more advanced, its nature became obvious because of its local spread to the trachea, œsophagus, neck muscles (pain behind the ear), involvement of nerves (vocal cord paralysis, Horner's syndrome, brachial plexus lesion), or even ulceration through the skin. Fixity of the thyroid gland due to carcinoma had to be differentiated from that due to inflammatory lesions, but the presence of regional or distant metastases established the diagnosis. Finally, in a third of the patients the correct diagnosis of malignancy was not made clinically but was only revealed at operation or on pathological examination.

Table X.—Progress of Patients from First Admission to Hospital until February, 1955



Ordinate : periods of follow-up. Each column represents one patient.

PROGRESS OF THE DISEASE

This paper is not concerned primarily with treatment, but it is necessary to describe what was done in order to trace the natural history of the disease. The various methods of treatment employed for each group of cancer patients are shown in *Table IX*.

It was not possible to calculate survival rates in a small, recently treated group of patients such as this. Therefore the progress of each individual was plotted graphically in *Table X*.

It was seen that over one-third of the patients with follicular Grade I tumours died within a period of six years from the time they first came under observation. Of the remainder, 5 have been followed for over five years.

Of the group with follicular Grade II cancers, half died within seven months of their first admission to hospital. Of those still alive, 1 case has been followed for just over seven years. Although the patients with Grade I follicular carcinomas showed a greater proportion of regional spread and distant metastasis when first seen than the Grade II group, the latter succumbed more frequently and within a shorter period of time.

There was only 1 death in the Grade I papillary carcinoma group. The patient was a woman of 66 with an advanced growth that had already metastasized to the lungs and compressed both trachea and œsophagus. There was also only 1 death among 3 patients with the Grade II papillary carcinoma. This patient died of the disease after being followed for six and a half years.

In the anaplastic group the large-cell carcinomas were the most malignant and rapidly growing of all thyroid tumours ; the 5 patients died within an average period of three months. The small-cell carcinomas were not quite so lethal. Three-quarters of the patients died within an average of six months, but 3 are still living, 2 of them after three and a half years.

SUMMARY AND CONCLUSIONS

1. Sixty-seven patients with thyroid cancer have been studied in an attempt to correlate the clinical and pathological findings.

2. Up to the age of 40 the incidence in both sexes was equal. Over 40 the ratio of women to men was 2·4 : 1.

3. The three histological groups had a distinctive age distribution.

4. Thirty per cent of the patients had a pre-existing goitre (i.e., a thyroid enlargement for more than ten years).

5. Malignant change in a long-standing goitre was nearly three times more often follicular than anaplastic in type.

6. Regardless of histological type half of the carcinomas had already metastasized to regional lymph-nodes by the time the patients were first seen.

7. Excluding the papillary tumour group, half of the patients presented with distant metastases whether the cancer was differentiated (follicular) or not (anaplastic).

8. Iodine uptake was found most commonly in follicular carcinomas, but was occasionally encountered in other types.

9. The disease was localized to the neck under the age of 30. The absence of distant spread thus favours a more radical surgical attack on thyroid carcinoma in the young.

10. There was a definite pattern of metastasis depending on the histological type of the tumour.

11. In over one-third of the patients a correct pre-operative clinical diagnosis was not made.

12. The subsequent clinical course showed good correlation with the histological classification and grading of the tumours.

We are greatly indebted to Dr. I. Doniach, who not only gave advice on the pathological material but also discussed the paper with us. The photomicrographs were prepared by Miss Rayner Klein, the tables by Mr. Saunders, and the photographs by Mr. Bicknell, of the Postgraduate Medical School.

REFERENCES

BEAL, J. M., SCHOLNICK, G. L., and STEVENS, G. A. (1952), *Arch. Surg., Chicago*, **65**, 879.

CERISE, E. J., RANDALL, S., and OCHSNER, A. (1952), *Surgery*, **31**, 552.

COFFEY, R. J., AMOROSO, W., and MAZZARA, [illegible] (1950), *Surg. Clin. N. Amer.*, **30**, 1693.

COLE, W. H., MAJARAKIS, J. D., and SLAUGHTER, D. P. (1949), *J. clin. Endocrin.*, **9**, 1007.

— — SLAUGHTER, D. P., and MAJARAKIS, J. D. (1949), *Surg. Gynec. Obstet.*, **89**, 349.

— — — — and ROSSITER, L. J. (1945), *J. Amer. med. Ass.*, **127**, 883.

COPE, O., DOBYNS, B. M., HAMLIN, E., jun., and HOSKIRK, J. (1949), *J. clin. Endocrin.*, **9**, 1012.

CRILE, G., jun. (1949), *Practical Aspects of Thyroid Disease*, 226. Philadelphia: W. B. Saunders Co.

— — and DEMPSEY, W. S. (1949), *J. Amer. med. Ass.*, **139**, 1247.

DUFFY, B. J., jun., and FITZGERALD, P. J. (1950), *Cancer*, **3**, 1018.

DUNCAN, J. A., CANTRIL, S. T., and LUND, P. K. (1952), *West. J. Surg.*, **60**, 435.

DUNHILL, T. P. (1931), *Brit. J. Surg.*, **19**, 83.

FISHER, E. R., and FISHER, B. (1951), *Amer. J. Surg.*, **82**, 202.

HARE, H. F. (1937), *Radiology*, **28**, 131.

HORN, R. C., jun., and RAVDIN, I. S. (1951), *J. clin. Endocrin.*, **11**, 1166.

KENNEDY, R. L. J. (1935), *J. Pediat.*, **7**, 631.

LAHEY, F. H., and HARE, H. F. (1951), *J. Amer. med. Ass.*, **145**, 689.

MAJARAKIS, J. D., SLAUGHTER, D. P., and COLE, W. H. (1953), *J. clin. Endocrin.*, **13**, 1530.

PEMBERTON, J. De J. (1938), *Trans. Amer. Ass. Goiter*, 154.

PERLOFF, W. H., and SCHNEEBERG, N. G. (1951), *Surgery*, **29**, 572.

RANKIN, F. W., and DONALD, J. M. (1933), *Surg. Clin. N. Amer.*, **13**, 927.

TAYLOR, S. (1951), *Postgrad. med. J.*, **27**, 54.

TINKER, M. B. (1934), *Surg. Gynec. Obstet.*, **58**, 468.

TROELL, A. (1946), *Acta chir. scand.*, **94**, 533.

WARREN, S., and MEISSNER, W. A. (1953), *Atlas of Tumor Pathology*, sect. IV, fasc. 14. Washington, D.C.: Armed Forces Institute of Pathology.

CONJOINED TWINS

BY JOHN HOLGATE AND B. J. IKPEME

DEPARTMENT OF MEDICAL SERVICES, EASTERN NIGERIA

REPORT OF A CASE

O. J., an African (Ibo) woman, about 24 years of age, who had had one previous delivery, was admitted to hospital five hours after giving birth to conjoined twin boys. The midwife who attended her described their birth thus :—

The head of infant A was born first face-to-pubes, with the umbilical cord twice round its neck. After the shoulders were born, the chest of infant A, and the legs and breech of infant B appeared together. The head of infant B followed the legs of infant A. The second stage of labour was completed in twenty minutes. Infant A cried immediately, but infant B was slow recovering from some degree of asphyxia. Their combined weight at birth was 8 lb. exactly.

On admission the infants appeared in good condition. Infant A was obviously smaller than infant B, but their faces had to be kept apart because there appeared to be a danger of suffocation. The two infants were connected by a 'bridge' that extended from the lower end of the sternums to the middle of the abdomens in the sagittal plane, and was two and a half inches in width (*Fig.* 770). From the middle of the lower border an umbilical cord of double normal size projected. In the upper border could be felt a hard rod-like connexion, between the lowest points of the sternums. The remainder of the 'bridge' felt soft, but no conclusions as to its contents, if any, could be reached. No other congenital abnormalities were found, though the position of their hearts could not be accurately determined.

AT OPERATION.—Operation was undertaken seven hours after birth, and the infants were separately anæsthetized, lying on warm water-bottles, with open chloroform and ether mixture.

An incision through skin and subcutaneous tissue was made from the centre of the upper border of the 'bridge' vertically downwards to the umbilical cord. It then curved to the lower border of the 'bridge' on infant B's side of the cord. A peritoneal lining to the 'bridge' was exposed and liver could be seen moving with respiration within it. The peritoneal cavity was then opened, and a liver 'bridge' one and a quarter inches in width was found connected to the upper border by projections of the triangular ligaments of both infants. In the centre, a vertical fissure appeared to indicate a septum at the junction of the two livers. Dissection was

attempted along this fissure, but this failed, and the liver 'bridge' was divided on infant A's side of the fissure. The cartilaginous rod at the upper border, and the rear wall of the 'bridge' were rapidly divided, with ligature of the umbilical vessels to infant B.

There was no bleeding from the raw surface of infant B's liver, and his abdomen was immediately closed. There was, however, considerable oozing from infant A's liver, but this was easily controlled by drawing the edges of the capsule together with catgut stitches which held well. The abdomen was closed with the cord projecting from the lower end of the wound.

The operation was concluded in thirty minutes.

The immediate post-operative condition of both infants was fair. The divided cartilaginous connexion had sprung back into line with the sternums forming rather long ziphisternums.

Each infant was given parentally 1500 units ATS., 50,000 units crystalline penicillin, and 5 mg. vitamin K.

POST-OPERATIVE PROGRESS.—

Infant A.—On the second post-operative day his right eyelids became swollen, and there was some discharge. This responded to penicillin drops and crystalline penicillin intramuscularly. There was also slight oozing of blood from the wound and a further injection of 5 mg. vitamin K was given.

On the third day his temperature rose to between 99° F. and 100° F., and although it was normal next day, jaundice became apparent, and the infant was noticeably weaker.

On the fifth day he suddenly collapsed, becoming pale and cyanosed. Oxygen was administered and his colour immediately improved; thereafter it was given in an improvised tent. The jaundice gradually deepened, and on the sixth day his temperature rose to 103° F. The cranial bones showed slight overlapping at the sutures and the feeds, which had not been taken well, were immediately increased, and given by an œsophageal tube. This was used until the sixteenth day, when the pipette, used previously, was reverted to again.

Continuous oxygen was stopped on the ninth day, but for the next three days it was given before and after feeds.

By the tenth day the jaundice had cleared; his temperature was normal by the twelfth, and it remained normal thereafter with only occasional rises to 99° F.

On the thirteenth day the stitches were removed and the wound was healed. The cord, the upper part of which had been transfixed with a stitch, did not separate until the fifteenth day.

He was put to the breast on the seventeenth day, and when weighed on the nineteenth day he was 3 lb. 10 oz.

Infant B.—Apart from slight fever on the second and third days this baby's progress was uneventful. Stitches were removed on the thirteenth day. His weight on the nineteenth day was 4 lb. He was fed by pipette until the sixteenth day when he was put to the breast.

On discharge from hospital, they both had umbilical hernias which were larger than those commonly found in African infants. Infant B was found to have dextrocardia but his stomach and liver were in their normal positions.

When last seen, aged seven months, both infants were doing well.

COMMENT

It appeared reasonable from clinical examination to expect both infants to be anatomically complete.

The main objection to immediate operation was the possibility of opening the pleura in the 'bridge'

FIG. 770.—Showing the 'bridge' from the lower end of the sternums to the middle of the abdomens and the large umbilical cord.

which the available methods of anæsthesia might have been inadequate to cope with.

If the operation had been postponed this 'bridge' would have grown larger, and it may well have become more complex in structure. This, together with the obvious advantage of operating shortly after birth, seemed to justify the risk. If the pleura had been met, it could probably have been closed and divided anyway, without allowing air to enter.

We should like to pay a tribute to the skill of the midwife Mrs. A. Nwosu in dealing with the complicated delivery. Our thanks are due to Dr. D. I. L. Nkemeh for supervising the anæsthetics, to Miss G. B. Killick, Senior Nursing Sister, Miss M. I. Njemanze, Nursing Sister, and Mrs. Members, Staff Midwife, who supervised the post-operative care, and to Mr. G. A. Jeffcock, Laboratory Superintendent, for the photographs.

We are indebted to the Director of Medical Services, Eastern Region of Nigeria, for permission to publish.

MISSILE HEAD WOUNDS IN THE KOREAN CAMPAIGN

A SURVEY OF BRITISH CASUALTIES

By WALPOLE LEWIN and R. MYLES GIBSON

FROM THE MILITARY HOSPITAL (HEAD INJURIES), WHEATLEY, OXON

In the report which follows, the debt which we owe to the American, Norwegian, and Danish neurosurgeons is clear. Although, fortunately, the series is a small one, yet the quality of the results leaves no doubt as to the extent of their efforts, and to the steady advances which have been made in the care of head wounds. Each campaign has its own problems and it was thought proper, therefore, not only to record the British casualties, but to comment on those changes which have taken place since the experience of the British neurosurgical units at the end of the second world war.

DURING the Korean war (June, 1950–July, 1953) the majority of the missile wounds of the head and spine occurring in British troops were treated by American neurosurgeons. A few were treated in Norwegian and Danish neurosurgical units working from hospital ships. On return home these patients were sent to the Military Hospital (Head Injuries) Wheatley, for further assessment and treatment. In this way we had the opportunity of studying 51 survivors from major missile wounds of the head. The complete figures and mortality-rates from the neurosurgical units in Korea are not yet available but from all the present records it would appear that this series includes the majority of survivors from penetrating head wounds among British troops. This paper discusses the line of evacuation which was followed and records the immediate results and early sequelæ in these cases.

LINE OF EVACUATION

There was no Commonwealth Casualty Clearing Station in Korea, and the main forward surgery depended on United States Mobile Army Surgical Hospitals, which on the average, were situated thirty miles behind the line (Harsant, 1953). In the Mobile Army Surgical Hospital was an American neurosurgical team, a detachment of the parent body which was based on the U.S. Army Hospital in Tokyo, Japan. To it were brought the neurosurgical cases direct from the Advance Dressing Station or Regimental Aid Post. Several cases, particularly those occurring in the last year of campaign were evacuated by helicopter, and this was one of the medical features of the Korean war. In some instances the pilots lived in the medical mess and were immediately available to evacuate priority cases. They flew, it should be noted, under almost ideal conditions, as no hostile enemy aircraft came up to interfere (Cantlie, 1952). Once the scheme was operating several patients with head wounds were undergoing definitive neurosurgical treatment within a few hours of wounding, and as far as one can judge from records and personal communication these head cases travelled safely and without complication by helicopter. Thus Barnett and Meirowsky (1955) reported that in the later stages of the campaign 78 per cent of patients were under definitive neurosurgical care within 8 hours after first medical aid. The Mobile Army Surgical Hospital neurosurgical unit had a post-operative ward, where patients could be held for some days following operation. In general the patients were evacuated by air within a week of operation to the American neurosurgical unit at the American Army Hospital in Tokyo, a distance of 600 miles (Meirowsky and Barnett, 1953). Here the cases were re-assessed and further neurosurgical operation carried out where indicated. Subsequently, the British casualties were transferred to the Commonwealth Hospital based on Kure in South Japan. From Kure these patients were evacuated by the R.A.F. to the United Kingdom using Hastings aircraft. The journey home from Kure, allowing for stages at Singapore and intermediate points, took about a week, and the average case arrived in the United Kingdom six weeks after injury.

OPERATIVE TREATMENT

TIME AFTER WOUNDING.—It is clear from our records that as the campaign stabilized and the helicopter service was established the interval between wounding and operation became shorter. Thus, during 1951, of the 20 British casualties, only two were operated on within the first 24 hours, the average interval being 2–3 days; whereas of the last 31 cases all but 7 were excised within 24 hours, the later ones very early indeed, within a few hours. One patient who was taken prisoner received no operation, and in 4 others operation was delayed from 3 to 20 days, for one reason or another.

SITE.—The sites of wounding were as follows:–

Vertex	20
Frontal	20
Temporoparietal	5
Occipital	4
Posterior fossa	2

In 8 cases the wounds were transventricular and in 4 of the frontal cases there was involvement of the paranasal air sinuses.

Technique.—This followed the usual practice of craniectomy with excision of the wound track and removal of bone chips and foreign bodies. General anæsthesia was employed in most cases. The principles have been recorded elsewhere (Ascroft, 1943; Eden, 1943; Small and Turner, 1947; Meirowsky, 1954).

The following features merit further comment.

Intracranial Hæmatoma.—An unusually high incidence was reported. Among the British casualties there were 16 cases, 1 extradural, 8 subdural, and 7 intracerebral clots, an incidence of 32 per cent. Barnett and Mierowsky (1955) have discussed this incidence in some detail. Of 316 penetrating head wounds treated in the last months of the Korean war, when nearly 80 per cent of cases reached the neurosurgical centre within eight hours of wounding, they found that 46·2 per cent had intracranial hæmatomas.

Schorstein (1947) in the North African and Italian campaigns of the second world war found 83 hæmatomas among 2000 head wounds, an incidence of 4·1 per cent. The disparity between the two sets of figures may not be so great as at first appears since Schorstein's figures included non-penetrating as well as penetrating wounds, and it is also possible that the criteria of a significant hæmatoma varied, small collections being included in the Korean figures. Barnett and Meirowsky felt that collections of 20 c.c. or more of blood-clot which had not a ready exit were significant. It should be noted also that Small and Turner (1947), in their report from north-west Europe, leave the impression, although not quoting figures, that a small hæmatoma in the missile track was common, as indeed one would expect. However, Barnett and Meirowsky found that the incidence of hæmatoma increased with earlier hospital care; at the beginning of the Korean campaign, for example, when the average time of operating after injury was 24–72 hours, the incidence of hæmatoma was only 7 per cent, rising steadily as rapid evacuation of casualties became possible and the neurosurgical unit was based further forward.

Although mortality figures are not given, it is clear that the early removal of some of these clots helped to lower the overall mortality and some cases with advancing cerebral compression were saved by timely intervention. But it should not be assumed that all these hæmatomas resulted in general cerebral compression, or would have done so, even if untreated. Indeed, Schorstein concluded that hæmatomas in missile wound tracks were by no means always progressive, nor did their removal, in many cases, appear to be a life-saving procedure. There is, however, a further point which has been suggested in these earlier papers; apart from a general rise in intracranial pressure, the increased destruction and pressure produced locally by a clot, particularly when it lies in a long brain track, and therefore probably involving vital structures, may be a factor in the death of some of these patients; and in others who recover, it may aggravate the ultimate neurological disability. These observations, therefore, from successive campaigns are cogent arguments for early surgery wherever possible; and suggest that in addition to evacuation of the rapidly enlarging clots which unattended would be fatal, early treatment of the wound track may also minimize the residual disability.

Dural Closure.—In all cases in this series, the dura was closed following excision, either by direct suture, or by a pericranial or fascia lata graft. Indeed, the view that closure of the dura is an essential part of the surgical management is gaining increasing acceptance and it might be useful, therefore, to set out its advantages and disadvantages. It should be noted that the British practice during the second world war was to leave the dura open, primary stress being laid on accurate scalp closure without tension. In favour of dural closure it is argued that the C.S.F. pathways are sealed from the superficial tissues and the risks of intracranial infection are thereby reduced; the herniation of the brain with possible further cerebral damage is restricted; that adhesions between the brain and superficial tissues are lessened, and that this may be a factor in reducing the incidence of post-traumatic epilepsy; also that subsequent procedures such as cranioplasty are made easier since there is a more satisfactory plane of cleavage. The disadvantages of dural closure were well set out by Ascroft (1943). He found that dural closure, even when the operation was performed a few hours after injury led, in fact, to an increased risk of sepsis, although it should be remembered that this series was compiled in the pre-penicillin era; moreover closure encouraged rise in tension in the wound track and that in a potentially contaminated track the patient's safety depended on the free outlet of exudate in the wound track into the sub-aponeurotic space.

All would agree that dural closure is essential in auro-petrosal wounds and in those involving the paranasal air-sinuses, and that it is also desirable for the large defects where considerable brain herniation is likely. But for the majority of uncomplicated wounds, the figures obtained by Small and Turner (1947), where the dura was left open, show that its closure is not a prime factor in preventing infection, nor do the present figures so far (loc. cit.) suggest that there is likely to be a significant fall in the incidence of traumatic epilepsy. The question of dural closure becomes important where a large number of casualties are to be treated, for dural closure may add materially to the operating time, and in adverse circumstances insistence upon it might detract from the thoroughness of the excision of the wound track. In the Korean campaign, where for the most part there was adequate operating time, this, with the earlier surgery after wounding showed dural closure to a good advantage; and we can certainly confirm the ease of later operations such as cranioplasty. Nevertheless the limitations of dural closure should be recognized. The position would seem to be that excision of the wound track and good scalp closure are the first essentials. Where it is possible to operate early and the wound track is clean with the brain slack after treatment, and antibiotics available, then the dura may be closed with safety; but where time is a factor or there is any doubt as to the state of the track, or the operation is delayed for 24 hours or more, then dural closure, far from being considered an essential part of the operation, should be discouraged.

The following case illustrates this point:—

Case 1.—(H. N. A/25667.) This patient, aged 22 years, received a left parieto-occipital penetrating wound in January, 1951, which was excised 5 days after injury. The missile track (which was found to extend deeply into the parietal lobe) was explored and bone fragments were removed from its depths. The cerebral tissue continued to herniate through the dural defect after the excision and by means of a soft rubber catheter a subdural hæmatoma of 15 c.c. was then removed from the occipital region. The dura was repaired with a pericranial graft, but this proved difficult and it was necessary to tap the right lateral ventricle for decompression. Whilst pre-operatively the patient had been alert, post-operatively he was apathetic and drowsy, had continuous generalized headache, vomited, and was febrile. On the ninth post-operative day he was noticed to have definite papillœdema. On several occasions during this period attempts were made to tap the subgaleal space but only 8 c.c. of sanguineous C.S.F. were obtained. The patient made a slow improvement and it was one month after operation before he was up and about. Later he was admitted to the Military Hospital, Wheatley, and there some three months after

injury he suddenly developed fever with meningism and the C.S.F. contained up to 200 white cells per c.mm. mostly polymorphs, but the cultures were sterile. This settled under appropriate antibiotic therapy and subsequent air studies showed no evidence of intracranial abscess. A year later tantalum cranioplasty was carried out uneventfully. The patient has been working since as a postman.

Opening the Intact Dura.—In this series, where the dura was found to be intact it was opened as a routine to exclude the presence of any intracranial clot and where necessary to suck out contused brain, the dura then being closed with silk. This was performed in 11 cases in this series. The teaching in the past has been to refrain from opening the dura unless there were obvious indications. One would question whether the removal of contused brain, unless under obvious tension, would indeed do harm rather than good, but certainly the exclusion of a hæmatoma in a doubtful case is of paramount importance. The practice of opening the dura in this series illustrates the increased latitude the surgeon may have with early surgery and antibiotics if he is in any doubt as to the state of affairs beneath the dura.

Re-exploration.—The relation of retained bone fragments to cerebral infection has been emphasized repeatedly in the past. In this series every step was taken to leave a perfectly clean brain track. In no less than 10 cases a secondary craniectomy was performed at the base hospital, in 8 to remove retained bone fragments and in 2 for suspected abscess. These explorations took place on an average 9 days after the primary operation. The justification for this rigorous policy is shown by the truly astonishing fact that we saw not a single brain abscess among the British troops who had had deliberate neurosurgical treatment, a striking testimony both to the surgical principles practised and individual skill.

INFECTION

Meirowsky and Harsh (1952) recorded an incidence of meningocerebral infection in the early phase of the Korean campaign of 41 per cent when wounds were untreated or inadequately treated, even though antibiotics were given from the beginning. Following the establishment of neurosurgical teams and with early excision the infection rate fell to 1 per cent. This low incidence of infection is reflected in the British casualties.

Wound Infection.—Of the 51 British cases recorded, 49 received definitive neurosurgical treatment in Korea, and of this group only one case developed post-operative wound infection, and this in a young soldier whose operation had been delayed 20 days.

Case 2.—(H. N. A/25707.) This patient, aged 20 years, received a comminuted gunshot wound in the right posterior parietal region during hand to hand fighting in January, 1951, and was taken prisoner. Fortunately, he was rescued by a subsequent counter attack and was returned to the neurosurgical unit where operation was carried out, 20 days after wounding. The depressed bone was removed and the dura was found to be intact. It was opened, a small amount of softened parietal cortex was removed, and the wound was then closed in layers. One week later the posterior limb of the wound broke down and *Staph. aureus* was grown on culture. It healed quickly but three months later the patient had a fit and developed an attack of meningitis which settled under antibiotic therapy. Eighteen months later he was well with a sound scar and cranioplasty was performed. The patient has been employed regularly as a motor mechanic.

Meningitis.—Similarly only 3 of these patients developed meningitis in the post-operative period; in 1 patient it followed a late excision with a stormy post-operative course (*Case* 1), the second patient had previously had an infected scalp wound (*Case* 2), and the third, to be described, had sustained a transventricular wound.

Case 3.—(H. N. A/27233.) This soldier, aged 20 years, sustained multiple injuries by shell fragment in November, 1951, including a severe abdominal wound which received priority in treatment, and a right posterior parietal penetrating wound of the head with metallic foreign bodies lodged in the left posterior parietal lobe. At operation 72 hours after injury, the head wound was found to be transventricular and there was a tear in the inferior third of the falx. The track was excised, the metallic foreign body in the left parieto-occipital lobe was deemed surgically inaccessible and left in situ, and the dura was closed with a pericranial graft. Post-operatively the patient developed meningism which was attributed to blood in the ventricle. On the eighth day he had a focal seizure involving the left side and became comatose. Re-exploration of the brain wound was promptly carried out and the missle tract was found clean but distended by ventricular C.S.F. There was no evidence of intracranial abscess or clot and the dura was repaired on this occasion with a fascia lata graft. Following this operation the patient's condition was critical for several days and the C.S.F. contained up to 500 white cells/c.mm. but all cultures were sterile. His subsequent course was one of slow but gradual improvement. On return to the United Kingdom, however, he developed meningeal signs on two further occasions with the C.S.F. containing up to 176 cells/c.mm., 56 per cent of which were polymorphs. On both occasions this improved on antibiotic therapy and subsequently ventriculography showed no evidence of abscess or other space-occupying lesion.

This patient was severely disabled as a result of his injuries with a left hemiplegia and some mental changes, and he had further epileptic attacks. After prolonged rehabilitation he was able to return home one year after his injury, but at the last follow-up he was not yet employed.

Brain Abscess.—Perhaps the most significant finding in relation to intracranial infection was the fact that there was not a single example of brain abscess among the British patients who had received definitive neurosurgical care in Korea. In most of these patients we have subsequently performed air studies and in no instance was there evidence of any residual space-occupying lesion. The major credit for this result must lie with early and effective surgery rather than with antibiotics, for, as Meirowsky and Harsh (1952) pointed out when recording 17 examples of brain fungus from Korea, which were seen in the early phase of the war, those cases had had adequate antibiotics given from the beginning but untreated or inadequately treated wounds.

ANTIBIOTICS

As far as may be judged from the records, penicillin was given systemically as a routine, with the addition of streptomycin in some instances. In one patient aureomycin was given. Meirowsky (1954), in a paper on general management advocates

penicillin 600,000 units and streptomycin 0·5 g. b.d. intramuscularly.

The sulphonamides do not appear to have been used very much, and certainly not in the routine prophylactic way that they were given in the 1939–45 War. In our routine management of open head wounds at Wheatley we still employ sulphadiazine as a prophylactic measure against meningitis. Its wide range of effectiveness and the high concentration obtainable in the C.S.F. pathways have much to commend it. The problems of bacterial resistance and other complications which are becoming increasingly apparent with the use of the newer antibiotics, suggest that it still has its place in treatment.

LATER MANAGEMENT

These patients arrived at Wheatley in excellent general condition. A full neurological examination supplemented by lumbar puncture, electro-encephalography, radiography, and in most cases pneumoencephalography, was carried out. Many patients required cranioplasty. Physiotherapy and occupational therapy were continued where necessary and final arrangements were made for the patient's future.

Residual Infection.—Of the 51 cases, the 49 who had received neurosurgical treatment in Korea all had soundly healed wounds on arrival at Wheatley. As described above, 3 required treatment for meningitis, which responded to appropriate therapy, and subsequent air encephalography showed no evidence of residual abscess. In no cases were there residual intracranial bone chips, but in 7 cases metallic foreign bodies remained. As indicated above there was no evidence of brain abscess.

Two of the 51 patients did not receive definitive neurosurgical treatment in the early stages. One received a penetrating transoccipital wound in July, 1952, during a night battle and was taken prisoner. He received no surgical treatment but the wound was dressed with ointments on several occasions. Subsequently he was returned home under the exchange of sick prisoners when he was found to be blind and the occipital wound partly healed with several small infected pockets which finally healed with appropriate treatment. The patient later developed epilepsy which handicapped his resettlement training at St. Dunstan's. The other patient received severe multiple injuries including a major compound limb fracture, the management of which had to take precedence over an apparently minor scalp laceration. A brain abscess developed subsequently and this was, in fact, the only example of brain abscess which we encountered from the Korean campaign.

Case 4.—(H. N. A/28056.) This patient, aged 19 years, was wounded on May 25, 1952, in a mortar engagement and received multiple injuries. These included soft tissue wounds of the chest and abdomen, a compound fracture of the right tibia and fibula and a small right posterior frontal scalp laceration. There had been no loss of consciousness. Eleven days after injury the patient complained of headache over the site of the scalp wound and a radiograph showed a metallic foreign body lodged in the skull. This was removed with forceps and the scalp wound was sutured. The patient was evacuated home in June, 1952. During the last few days of this trip he again complained of severe headache, vomited several times and on admission to the Military Hospital (Head Injuries), Wheatley, on June 27, 1952, he was found to be ill, with a discharging scalp wound, frank meningitis, and early papilloedema with a mild left hemiparesis. The lumbar C.S.F. was under a pressure of 250 mm., with 1900 white cells, 75 per cent of which were polymorphs, and culture sterile. The clinical signs suggested that the patient had a brain abscess in addition to his meningitis, and cerebral angiography confirmed the presence of a right posterior frontal space-occupying lesion.

The meningitis was treated with intrathecal penicillin and sulphadiazine by mouth, and the head wound was explored on July 2. At operation the scalp wound was excised and beneath was found a guttered depressed fracture which had penetrated the dura. After removing the depressed bone the brain was needled and a thick walled cerebral abscess containing 30 c.c. of pus was aspirated. Cultures were sterile. This was treated by repeated aspiration and instillation of penicillin and subsequently the abscess and the scar of the wound tract were excised. Post-operatively the patient had several focal epileptic attacks and three months later had his first generalized seizure. When last seen, three years after wounding, the patient was well, and had resumed his undergraduate studies. He was having focal seizures without loss of consciousness about once every six weeks and remained on regular anticonvulsant treatment.

Bone Defects and Repair.—The skull defects varied in size, the largest being 10 × 6 cm., the average 4 cm. in diameter. In all cases the bone edges appeared healthy radiographically. Of these 51 cases, cranioplasty was considered unnecessary in 23, and in 2 it was advised but the patients declined operation. Cranioplasty has been carried out so far in 19 cases and for this purpose we have continued to use tantalum, which has given satisfactory results. The technique has been described from an earlier series (Lewin, Graham, and Northcroft, 1948).

SEQUELÆ

Neurological Disability.—Residual neurological disability remained in 17 patients but in only 6 was it severe. Thus 3 patients were left with a nominal dysphasia, but in only 1 was it marked. Five patients had a residual spastic hemiparesis and 5 more a facial weakness only. Visual field defects were present in 6 patients, in 4 as the only neurological deficit including the patient with the transoccipital wound who was left virtually blind, and in 2 together with a hemiparesis. Three other patients lost an eye from direct injury.

Epilepsy.—Since leaving Wheatley, all these patients have been followed up for at least two years after wounding. While it is yet early to make a definitive statement with regard to the incidence of epilepsy, so far 18 (36 per cent) have had at least one fit since wounding. Detailed electro-encephalographic studies have been made in all who have had a fit, and in 3 a spike focus has been demonstrated. Despite this high incidence it should be noted that 5 patients had their fits in the pre- or early post-operative period and have had none since so far. In only 5 patients so far have the fits been of such severity or frequency (at least 1/ month) as to impose major limitations on their activities.

It should be recalled that Russell and Whitty (1952) found the incidence of epilepsy among the missile head injuries of the second world war to be about 40–45 per cent. Of these, 73 per cent had their first fit within a year of wounding and a further 18 per cent within two years. The present figures

suggest that the incidence from the Korean series will be about the same as the 1940–45 incidence. The significance of this is apparent in the light of the observations made earlier on surgical management.

RESETTLEMENT

Of the 51 patients recorded here, 5 returned to duty and 40 were able to go straight home on discharge from the Army. Five patients, seriously handicapped as a result of hemiplegia, dysphasia, or both, were sent to Headington Hill Hall Rehabilitation Centre for further care and subsequently 2 of them have gone home. One patient went to St. Dunstan's, where he is making excellent progress with his blind training. The late results show that within a year of injury, 42 men (82 per cent) were in gainful employment. The range of jobs was wide and varied, including for example, a painter and decorator, heavy woodworker, garage mechanic, miner, plumber, clerk, railwayman, and salesman. Only 9 patients are still unemployed as a result of their disabilities. Motor deficits are responsible in 4 cases, dysphasia in 1, blindness in 1, epilepsy in 1, and multiple disabilities in 2. Active management and treatment is still being given to these patients.

CONCLUSIONS

The experience of the British neurosurgeons during the second world war were recorded in the BRITISH JOURNAL OF SURGERY Supplement on Head Injuries and in the reports of Ascroft and Eden. The recognition of the essential points of the surgical management and the later advent of antibiotics made it possible for Small and Turner in the final north-west Europe campaign of 1944–5 to record a primary wound healing rate of 86 per cent and a mortality from infection of 5 per cent even though less than half the cases were operated on within twenty-four hours of wounding. It is therefore interesting to see what may be learned from the differing conditions occurring in the Korean campaign and the further developments in surgical technique and antibiotic therapy. The value of special neurosurgical units is confirmed and the use of the helicopter has been shown not only to be practicable but an important contribution to the early treatment of head wounds. The routine use of antibiotics, short of allowing the surgeon to delay operation, has been shown to be at its best when combined with early and effective surgery as attested by the remarkable figures obtained by our colleagues working in Korea. The possibility that such early surgery for the badly wounded patient would be attended by severely disabled survivors is happily not realized, at least in so far as may be judged from these figures; indeed it may be argued from the figures of intracranial hæmatoma quoted that early operation may in fact reduce the final disability. To be able to return 82 per cent of the patients to work within a year of wounding shows the improvements that are still being made.

SUMMARY

1. The treatment of missile wounds of the head among the British troops treated in Korea is outlined and their subsequent care and disposal in this country described.

2. The importance and significance of the high incidence of intracranial hæmatomas in the series is discussed, together with other points of surgical technique.

3. Of the 51 cases, 49 received definitive neurosurgical care in Korea and among these there was only 1 case of wound infection, 3 of meningitis, and no example of brain abscess. Some of the reasons for this low incidence of infection are given.

4. Relatively few patients were severely disabled and within a year of wounding 82 per cent of patients returned to work. The arrangements for the rehabilitation of the patients in this country are described.

Our thanks are due to Dr. A. M. Meirowsky of Cincinnati University and Dr. J. Barnett of Emory University, Georgia, for the help they have given in the preparation of this report, and to whose papers the reader is referred for further details of the campaign; to Dr. Henry Liss of Columbia University who gave us a personal account of his experience with a neurosurgical unit in a hospital ship; and to Brigadier J. Huston, R.A.M.C., Consulting Surgeon to the Army, for his helpful criticism.

REFERENCES

ASCROFT, P. (1943), *Lancet*, **2**, 211.
BARNETT, J. C., and MEIROWSKY, A. M. (1955), *J. Neurosurg.*, **12**, 34.
CANTLIE, N. (1952), *Brit. med. J.*, **2**, 1253.
EDEN, K. (1943), *Lancet*, **2**, 689.
HARSANT, G. (1953), *Proc. R. Soc. Med.*, **46**, 1037.
LEWIN, W., GRAHAM, M. P., and NORTHCROFT, G. B. (1948), *Brit. J. Surg.*, **36**, 26.
MEIROWSKY, A. M. (1954), *J. Amer. med. Ass.*, **154**, 666.
— — and BARNETT, J. C. (1953), *Ann. Surg.*, **138**, 178.
— — and HARSH, G. R. (III) (1952), *J. Neurosurg.*, **10**, 373.
RUSSELL, W. R., and WHITTY, C. W. M. (1952), *J. Neurol. Psychiat.*, **15**, 93.
SCHORSTEIN, J. (1947), *Brit. J. Surg.*, War Suppl., *Wounds of the Head*, 96.
SMALL, J. M., and TURNER, E. A. (1947), *Ibid.*, 62.

TUMOURS OF THE DIAPHRAGM

By FRANK NICHOLSON and RAYMOND WHITEHEAD

FROM MANCHESTER ROYAL INFIRMARY AND THE DEPARTMENT OF PATHOLOGY, UNIVERSITY OF MANCHESTER

PRIMARY tumours of the diaphragm are rare but at least 44 cases have been reported; the literature is reviewed by Clagett and Johnson (1949) and Crimm and Kiechle (1952). *Table I* is a revision of Crimm and Kiechle's *Table I*. We have omitted cysts and also a doubtful 'round cell sarcoma' (Dalzell, 1887), and have added the following 11 cases: 2 adenomas (Keirns, 1952); 1 angiofibroma (Tuohimaa, 1950); 1 fibrolipomyxoma (Desaive and Closon, 1952); 1 fibrolymphangioma (De-Ponti, 1952); 1 hæmangioma (Döderlein, 1938); 1 leiomyofibroma (Freedlander, Wolpaw, and Mendelsohn, 1950); 3 lipomas (Clagett and Johnson, 1949); and 1 fibrosarcoma (Donati, quoted by De-Ponti, 1952).

Table I.—PRIMARY TUMOURS OF THE DIAPHRAGM

BENIGN		MALIGNANT	
Adenoma, adrenal cortical	1	Fibroangio-endothelioma	1
,, liver tissue	1	Fibromyosarcoma	1
Angiofibroma	2	Fibrosarcoma	7
Chondroma	1	Hæmangio-endothelioma	1
Fibrolipomyxoma	1	Leiomyosarcoma	1
Fibrolymphangioma	1	Mesothelioma	1
Fibroma	1	Myosarcoma	1
Fibromyoma	2	,, undifferentiated	1
Hæmangioma	1	Neurofibrosarcoma	2
Leiomyofibroma	1	Rhabdomyosarcoma	2
Lipoma	7	Sarcoma	1
Lymphangioma	1	,, endothelial	1
Neurofibroma	1	,, mixed-cell	1
Rhabdomyofibroma	1	,, undifferentiated	1
Total	22	Total	22

Table I shows that the diaphragm has been the seat of a wide variety of benign and malignant tumours. The diagnostic pattern is what one would expect in a connective tissue; the only distinctive tumours, due to the anatomical relations of the diaphragm, seem to be the adrenal and hepatic adenomas. Of the total 44 cases, 22 were benign and 22 malignant; the commonest benign tumours were lipomas and the commonest malignant tumours were fibrosarcomas.

We now describe a malignant tumour that lay within the diaphragm; histologically it bore no resemblance to any other diaphragmatic tumour known to us; we could not determine its tissue of origin, or whether it was primary or secondary, and for this reason we have not included it in *Table I*.

CASE REPORT

The patient was a girl aged 11 years, admitted to the Manchester Royal Infirmary in May, 1950. Two months previously her mother had noticed that the child tired easily and that her abdomen was unduly large. There were no other significant symptoms.

ON EXAMINATION.—The child was febrile and she continued to have an evening temperature around 100°F. until after removal of the tumour. The most obvious feature was a swelling of the left lower chest, which expanded the rib cage both in front and behind. The mediastinum was displaced to the right; most of the left hemithorax, except for the apex, was immobile and dull to percussion, breath-sounds being absent. There was a smooth, firm mass in the left hypochondrium, which was continuous above with the chest wall, with which it moved. The rest of the abdomen was normal, and there were no enlarged lymph-glands.

Radiographs showed a very large opacity, with a rounded upper surface, occupying two-thirds of the left chest and displacing the heart to the right (*Figs.* 771, 772). There was destruction and also some new bone formation in the ninth rib (*Fig.* 773); the other ribs were pushed apart. A barium-meal examination showed that the fundus of the stomach was considerably depressed by the tumour (*Fig.* 774). A mild anæmia was present, the red cell count being 4·15 million per c.mm., the hæmoglobin 78 per cent (11·5 g. per 100 c.c.), and the colour index 0·93; the red cells were of normal size and shape, but many were nucleated. The white cells totalled 10,700 per c.mm., of which 79 per cent were polymorphs. The urine was normal.

The most probable diagnosis seemed to be a dermoid tumour, possibly undergoing malignant change. The local destruction of the ninth rib might have been due to pressure, but invasion by malignant growth seemed a more likely cause.

EXPLORATORY THORACOTOMY.—This was performed through the bed of the sixth rib. There was a little blood-stained pleural effusion; the lung was compressed up in the apex by a large mass in the lower chest. On further examination it was evident that the tumour was not in the pleural cavity at all, but either below the diaphragm or within it, for the thin aponeurosis of the central tendon of the diaphragm was above it. This was a surprise, which called for a pause while we considered whether we had stumbled on a renal tumour, mistaking it for a dermoid. An attempt to get a biopsy specimen by aspiration showed that the tumour was vascular, for blood flowed freely into the syringe. As not enough tissue was collected by this method, a piece of the tumour was obtained by incising the diaphragm directly over it. The tumour was very cellular and vascular, and appeared malignant. The chest was therefore closed, no attempt being made to remove the tumour.

The biopsy showed that the growth consisted of sheets of small rounded cells. Mitoses were scanty. The sheets contained many large blood spaces. The growth was not identifiable, but resembled embryonic liver, and the most probable diagnosis was hepatoblastoma.

It was thought advisable to consider radiotherapy before attempting to remove the tumour, which we now believed to be arising from the left lobe of the liver. Dr. Ralston Paterson, of the Christie Hospital, was consulted and replied that such literature as exists does appear to suggest that primary hepatic tumours are radio-resistant, and do not respond; he therefore thought that surgery would offer the child a better chance than radiotherapy.

The child was wasting, the pyrexia was continuing, and the tumour seemed to be getting bigger; a second operation was therefore performed four weeks after the exploratory thoracotomy.

REMOVAL OF TUMOUR.—The abdomen was opened through an oblique incision extending from the ninth costal cartilage to the umbilicus. To our surprise, the tumour appeared from below just as it had done from above; it was not in the abdomen but separated from the abdomen by peritoneum and muscle-fibres on the lower

surface of the diaphragm. The liver was quite normal and not adherent to the tumour. If the chest had not been previously opened, it would have been assumed that the tumour was intrapleural; whereas it was in the diaphragm, bounded above by the pleural reflection and aponeurosis of the diaphragm, and below by the peritoneal reflection and muscle of the diaphragm. The laparotomy was then extended along into the chest through the eighth and ninth intercostal spaces, so that the eroded rib could be resected *en bloc* with the tumour.

FIG. 771.—Radiograph showing a large tumour in the left chest.

FIG. 772.—Left lateral radiograph showing tumour in chest.

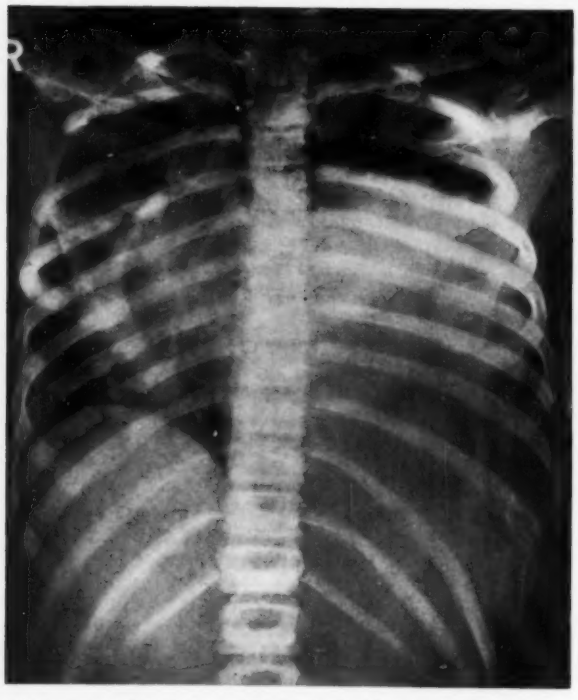


FIG. 773.—Penetrating radiograph showing erosion of ninth left rib, with new bone formation in the intercostal muscles.

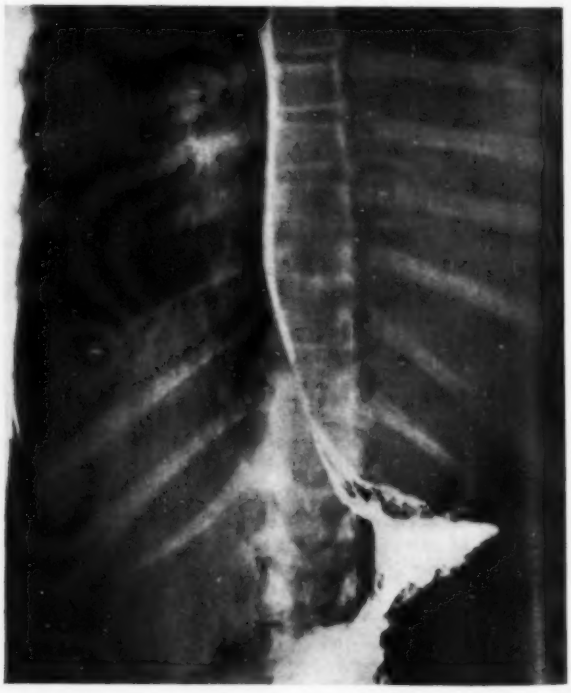


FIG. 774.—Barium radiograph showing deformed depressed fundus of stomach.

Once more the tumour was aspirated in order to reduce its size, but it proved to be multilocular, and the aspiration was of no value. Very easily the attenuated diaphragm, with pleura above and peritoneum below, was

stripped away from the tumour by finger dissection; the only pedicle appeared to be in the region of the ninth intercostal nerve in the posterior axillary line. This nerve, with the ninth rib and its periosteum and vessels, was removed with the specimen. The ease with which the tumour almost fell out made it seem innocent, and its pedicle near the intercostal nerve made it appear that this was a very vascular neurofibroma. The attenuated stretched diaphragm was easily repaired, and the thoracic and abdominal wounds were closed.

POST-OPERATIVE HISTORY.—There was immediate improvement in the child's respiration, and within six days the temperature fell to normal and remained so. She left hospital eighteen days after the operation and did well for five months. Then the tumour recurred in the chest wall in the seventh and tenth intercostal spaces. A radiograph confirmed the presence of a new pleural effusion. The child was re-admitted to hospital two weeks later, and then a mass was found in the lower abdomen, which we considered to be metastatic. There were no enlarged lymph-glands and the liver was not palpable. Dr. Ralston Paterson kindly undertook to treat the recurrences with radiation, but without much hope for palliation. She had a course of radiation to the whole trunk. The mass in the abdomen and the recurrences on the chest wall disappeared. In view of its extreme radio-sensitivity, Dr. Paterson thought the tumour was more likely to be an angio-endothelioma than a hepatoblastoma. The patient was last seen at the Manchester Royal Infirmary four months after her X-ray therapy, when she was well with no sign of recurrence and putting on weight. Three months later, in September, 1951, just fifteen months after her first operation, she died at home. No post-mortem examination was held, and no final clinical details were obtained from her doctor.

FIG. 775.—The tumour after removal, showing cystic appearance in places. Attached to the tumour is a segment of rib with parietal muscles.

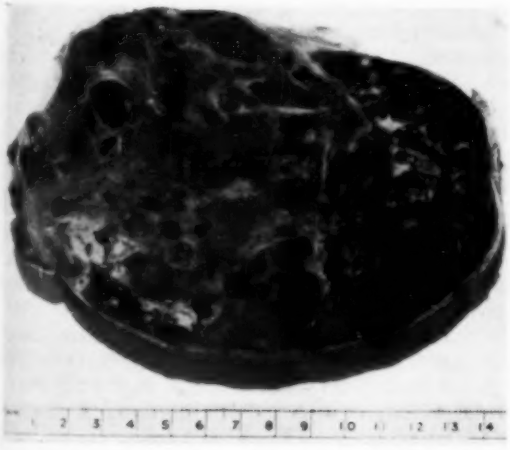


FIG. 776.—Tumour cut open, showing sponge-like appearance.

THE TUMOUR.—The tumour was a smooth, fluctuant, ovoid mass about 20 cm. long and 14 cm. broad enclosed in a thin capsule of grey fibrous tissue (*Fig.* 775). When cut open, the tumour resembled a sponge full of clotted blood (*Fig.* 776); the sponge-like appearance was produced by a coarse reticulum of grey fibrous bands occupying the whole cut surface and connected with the capsule; the interstices were filled with red and fawn solid material representing blood-clot and tumour, which were not distinguishable from each other on macroscopic examination. The growth was clearly multilocular, but its nature was not obvious.

HISTOLOGY.—Paraffin sections were stained with hæmalum and eosin, hæmatoxylin and eosin, and van Gieson's stain for connective tissue. The capsule and reticular stroma of the tumour consisted of fairly cellular fibrous tissue containing well-formed blood-vessels, some of them large. The tumour tissue consisted of small round and oval cells (*Fig.* 777). The outlines of the cells were not clearly visible, but the cytoplasm was abundant enough to separate adjacent nuclei. The nucleus was always sharply defined, and rather pale because chromatin was only moderate in amount. When stained with hæmalum, the nucleus was a transparent medium blue, and often contained many well-defined small dots of dense chromatin stained a much darker blue. Mitoses were scanty, and all those seen were of the normal type. The arrangement of the cells varied greatly from point to point. Sometimes the cells formed solid sheets up to a centimetre across (*Fig.* 778) and contained many blood-vessels; at the other extreme, the tumour cells were arranged in long narrow strands bathed in blood (*Fig.* 779). The cells lining the blood spaces were often flattened, resembling vascular endothelium (*Fig.* 780). No distinctive features, such as rosettes or fibres, were seen in the tumour tissue, nor was there any evidence of necrosis.

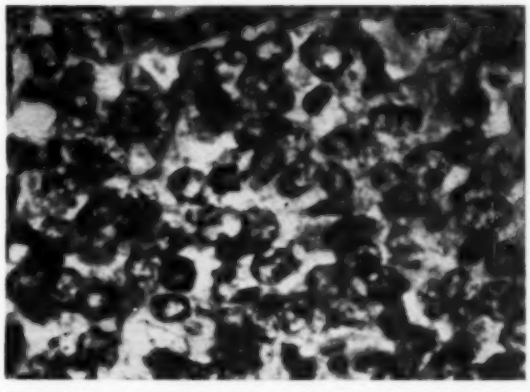


FIG. 777.—Tumour tissue composed of round and oval cells. (van Gieson.) (× 720.)

DISCUSSION

Diagnosis.—There are no characteristic signs or symptoms of diaphragmatic tumour. A mass may be palpable and may be accompanied by pain, usually thoracic but sometimes abdominal; on the other hand the tumour may be asymptomatic and come to light on routine radiographic examination, like the leiomyofibroma reported by Freedlander and others (1950). Radiography can lead only to a provisional diagnosis; its inconclusive nature is illustrated by a case discussed by Cass and Mallory (1936). The pre-operative diagnosis was 'tumor of the diaphragm', but at operation and biopsy the lesion was found to be a primary carcinoma of the liver arising in a cirrhotic liver; Mallory mentioned two other cases of primary carcinoma of the liver that had similarly elevated the diaphragm. When the presence of a mass in the diaphragm is suspected, the correct procedure is exploratory thoracotomy, but laparotomy may also be needed, as it was in our case, to determine the situation of the mass.

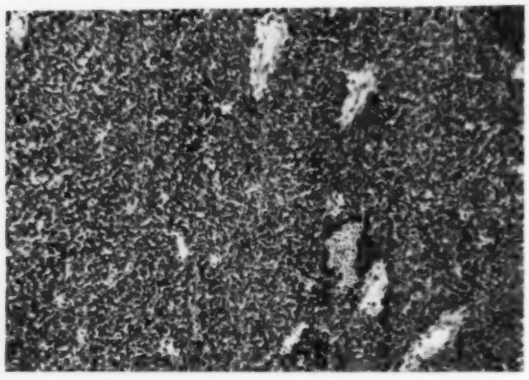


FIG. 778.—Tumour growing in solid sheet containing blood vessels. (van Gieson.) (× 80.)

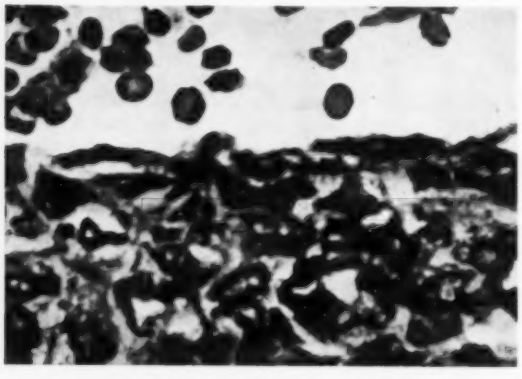


FIG. 780.—Flat, endothelium-like tumour cells lining a blood space. (H. and E.) (× 720.)

Treatment.—In the case we report, the problem of treatment arose before the tumour had been precisely located. Exploratory thoracotomy and biopsy showed that we were dealing with a malignant growth either below the diaphragm or within it, and at this stage we had to choose between advising radiotherapy and excising the tumour. If we had thought that the growth would be as radio-sensitive as it ultimately proved to be, we should have advised radiotherapy in preference to surgery, forgoing exact knowledge of the situation of the tumour; but the biopsy diagnosis of hepatoblastoma, with its reputed resistance to irradiation, tipped the scales in favour of surgery. At the time of removal of the tumour we assumed that it was primary, but even if it was secondary, as we now think not unlikely, we should still have advised excision for the relief of symptoms. The decision to remove the tumour was vindicated by the prompt and sustained improvement in the child's condition that followed.

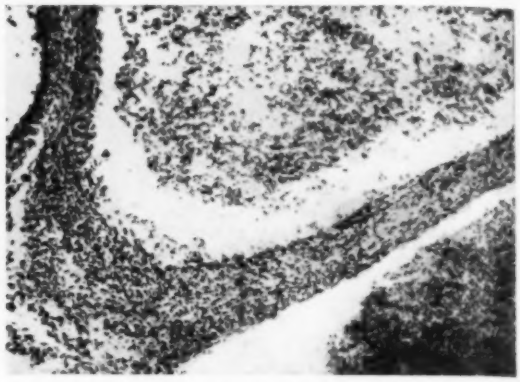


FIG. 779.—Tumour growing in narrow strands bathed in blood. (H. and E.) (× 80.)

Pathology.—The general nature of a mass from the diaphragm may be obvious on macroscopic examination of the specimen removed at operation or autopsy, but the lesion can be identified—if at all—only after microscopical examination. It may be impossible to say for certain whether a diaphragmatic tumour is benign or malignant; for instance, Gale and Edwards (quoted by Crimm and Kiechle, 1952) received widely different opinions from competent pathologists about their 'endothelial sarcoma' (listed as such in our *Table I*) and think that it might have been benign; and in the case described as 'fibrosarcoma' by Crimm and Kiechle the tumour first removed appeared benign, and but for a recurrence the case would have been reported as one of leiomyofibroma.

When a diaphragmatic tumour is malignant, the possibility of its being secondary must be considered. We have found no statistics on the frequency of secondary tumours in the diaphragm, but several cases are on record. The earliest paper on the subject known to us is that of Rajewsky (1876), who discussed metastasis to the diaphragm from carcinomas of the liver and stomach. Secondary deposits from a carcinoma of the liver were described by Orsós (1930), and carcinomatous invasion from an unspecified source is illustrated by Willis (1950). In a case reported by Binney (1931 a, b) the primary growth was recognized as bronchial; a similar case was diagnosed by Fenton (1934) as primary carcinoma of the diaphragm, despite the radiographic finding of lung shadows suggestive of tumour. Bronchial carcinoma may also be the correct diagnosis of Dalzell's 'round cell sarcoma' (1887), but the data are insufficient for a definite opinion. A remarkable case was reported by Paraf and Abaza (1933): the primary growth was a sarcoma of the spleen, the growth and its diagnosis being discussed in detail.

In studying our own case, the main pathological questions to be considered were what tissue the growth was derived from, and whether the growth originated in the diaphragm. In the course of examination and treatment, five diagnoses suggested themselves, in the order named: dermoid tumour, renal tumour, hepatoblastoma, neurofibroma, and angio-endothelioma. The two operations enabled us to rule out dermoid tumour and renal tumour, while histologically the growth did not resemble a neurofibroma. This leaves for initial consideration hepatoblastoma and angio-endothelioma.

The growth bore a general resemblance to embryonic liver tissue, and it seems possible that a hepatoblastoma could arise in ectopic liver tissue in the diaphragm; that such tissue does occur in the diaphragm is shown by the report of a hepatic adenoma by Keirns (1952). On the other hand, the age of 11 would be late for an embryonic liver-cell tumour to declare itself, and a further point against this diagnosis is the remarkable response of the tumour to radiation. Indeed it was this response that suggested the possibility of angio-endothelioma, and the hæmorrhagic character of the growth was consistent with it; in considering this, we recalled that VanAlstyne (1945) had reported a hæmangio-endothelioma of the diaphragm in a girl aged 26 days. Unfortunately angioblastic tumours are hard to identify, because they may be histologically indistinguishable from carcinomas or from sarcomas of non-vascular origin; no conclusion can be drawn from the presence of blood-filled spaces lined by flattened cells, since these could be carcinoma cells or sarcoma cells other than angioblasts. We therefore next discuss the possibility of carcinoma and of sarcoma of non-vascular origin.

Carcinoma is unlikely in so young a patient, but sarcoma is certainly possible—in fact a rhabdomyosarcoma of the diaphragm in a boy of 14 was described by Peery and Smith (1939). In their case the nature of the growth was evident; but our tumour showed no structure indicating a connective-tissue origin, and we are therefore not entitled to call it a sarcoma. One further diagnosis merits consideration—namely that of neuroblastoma.

Neuroblastoma is one of the commonest malignant tumours of childhood. While it occurs oftenest in early infancy, it may appear so long as any undifferentiated neuroblastic tissue remains. Our patient was within the possible age range, and the tumour could have been either primary or secondary; the absence of rosettes does not exclude the diagnosis, especially if the tumour was metastatic. Secondary neuroblastomas may be much larger than the primary and the abdominal mass that we thought was metastatic could have been an enlarging primary growth in an adrenal medulla or the sympathetic nervous system. Features of our tumour suggestive of neuroblastoma were hæmorrhage, radio-sensitivity, invasion of bone, and histological resemblance to hepatoblastoma.

Our final diagnosis has to be the unsatisfying one of undifferentiated malignant tumour in the diaphragm, possibly primary, possibly secondary. The microscopical appearances were consistent with the diagnoses of hepatoblastoma, angio-endothelioma, carcinoma, sarcoma, and neuroblastoma, and any preference for one or more of these must be based on grounds other than histological. The radio-sensitivity of the growth would support the diagnoses of angio-endothelioma and neuroblastoma; the general incidence of malignant tumours in childhood suggests a preference for sarcoma or neuroblastoma. The possibilities might have been narrowed by a post-mortem examination, and if we have been at fault in our study of the case, it is in failing to make special efforts to get one.

SUMMARY

An undifferentiated malignant tumour in the diaphragm of a girl aged 11 years is described. It resembled a blood-filled sponge and consisted of small round and oval cells. Possible diagnoses include angio-endothelioma, sarcoma, and neuroblastoma. The growth could have been either primary or secondary.

The tumour was resected with relief of symptoms, and recurrences disappeared after radiotherapy, but the child died fifteen months after clinical diagnosis. There was no autopsy.

A list of 44 primary diaphragmatic tumours is given; 22 were benign and 22 malignant, the commonest types being lipoma and fibrosarcoma. Secondary carcinoma and sarcoma in the diaphragm have also been reported.

We are indebted to Dr. John Ball for reading the manuscript. *Figs.* 771–774 are by the Department of Medical Illustration, Manchester Royal Infirmary, *Fig.* 775 is by Miss Christine Court, *Fig.* 776 is by the late Mr. F. Ward, and *Figs.* 777–780 are by Mr. E. Booth.

REFERENCES

BINNEY, H. (1931, a), *Trans. Amer. surg. Ass.*, **49**, 110.
— — (1931, b), *Ann. Surg.*, **94**, 524.
CASS, J. W., and MALLORY, T. B. (1936), *New Engl. J. Med.*, **214**, 209.
CLAGETT, O. T., and JOHNSON, M. A. (1949), *Amer. J. Surg.*, **78**, 526.
CRIMM, P. D., and KIECHLE, F. L. (1952), *J. thorac. Surg.*, **23**, 360.
DALZELL (1887), *Glasg. med. J.*, **27**, 298.
DE-PONTI, C. (1952), *Radiol. med., Torino*, **38**, 426.
DESAIVE, P., and CLOSON, J. (1952), *J. int. Chir.*, **12**, 272.
DÖDERLEIN, H. (1938), *Zbl. allg. Path. path. Anat.*, **71**, 193.
FENTON (1934), *Brompton Hosp. Reports*, **3**, 164.
FREEDLANDER, S. O., WOLPAW, S., and MENDELSOHN, H. J. (1950), *Radiology*, **55**, 700.
KEIRNS, M. M. (1952), *Ibid.*, **58**, 542.
ORSÓS, F. (1930), *Beitr. path. Anat.*, **84**, 33.
PARAF, J., and ABAZA, A. (1933), *Bull. Soc. méd. Hôp. Paris*, **49**, 480.
PEERY, T. M., and SMITH, W. A. (1939), *Amer. J. Cancer*, **35**, 416.
RAJEWSKY, A. (1876), *Virchows Arch.*, **66**, 154.
TUOHIMAA, E. T., (1950), *Ann. Chir. Gyn. Fenn.*, **39**, 206.
VANALSTYNE, W. K. (1945), *Amer. J. Roentgenol.*, **53**, 373.
WILLIS, R. A. (1950), *The Principles of Pathology*, 425, London: Butterworth.

GRANULOMA OF THE NECK FOLLOWING THOROTRAST ANGIOGRAPHY

By LAURENCE F. LEVY

FROM THE DEPARTMENT OF NEUROLOGY AND NEUROSURGERY, MCGILL UNIVERSITY AND THE MONTREAL NEUROLOGICAL INSTITUTE

THOROTRAST once enjoyed considerable popularity as a contrast medium in angiography and hepatolienography, but its routine use in these investigations has now been abandoned by most clinicians. Thorium dioxide, the main ingredient, is radio-active and, since it is not excreted from the body but is stored in the liver and spleen, it is at least potentially liable to cause malignant change. No case of malignant or other disease occurring in humans can be traced directly to the exhibition of the drug; however, subsequent to its use the following cases have been described: sarcoma of the liver (MacMahon, 1947); fibrosis of the liver (Jonsell and Lindgren, 1944; Jacobson and Rosenbaum, 1938; Cassel, Ruffin, Reeves, and Stoddard, 1951); aplastic anæmia (Spier, Cluff, and Urry, 1947) and generalized necrosis of the lymph-glands (Naegeli and Lauche, 1933).

In addition to its possible harmful systemic effects there are also undesirable local sequelæ should any of it escape into the perivascular tissues at the time of its injection into an artery or vein. Granulomata may form which involve the surrounding soft tissues in a hard fibrous reaction and, although no malignant change has likewise been reported in man, Selbie (1936), and Foulds (1939), have produced transplantable malignant growths by subcutaneous injection of this material into guinea-pigs and rats.

Cases of thorotrastoma of the neck have been reported by Blades and others (1949), Jones, (1951), and Struppler (1952), while there are other reports of such development following attempts at intravascular injection elsewhere in the body (Fleming and Chase, 1936; Kuntzman, Gross, and Meyer, 1950), and after intramammary duct injection (Mora, 1940).

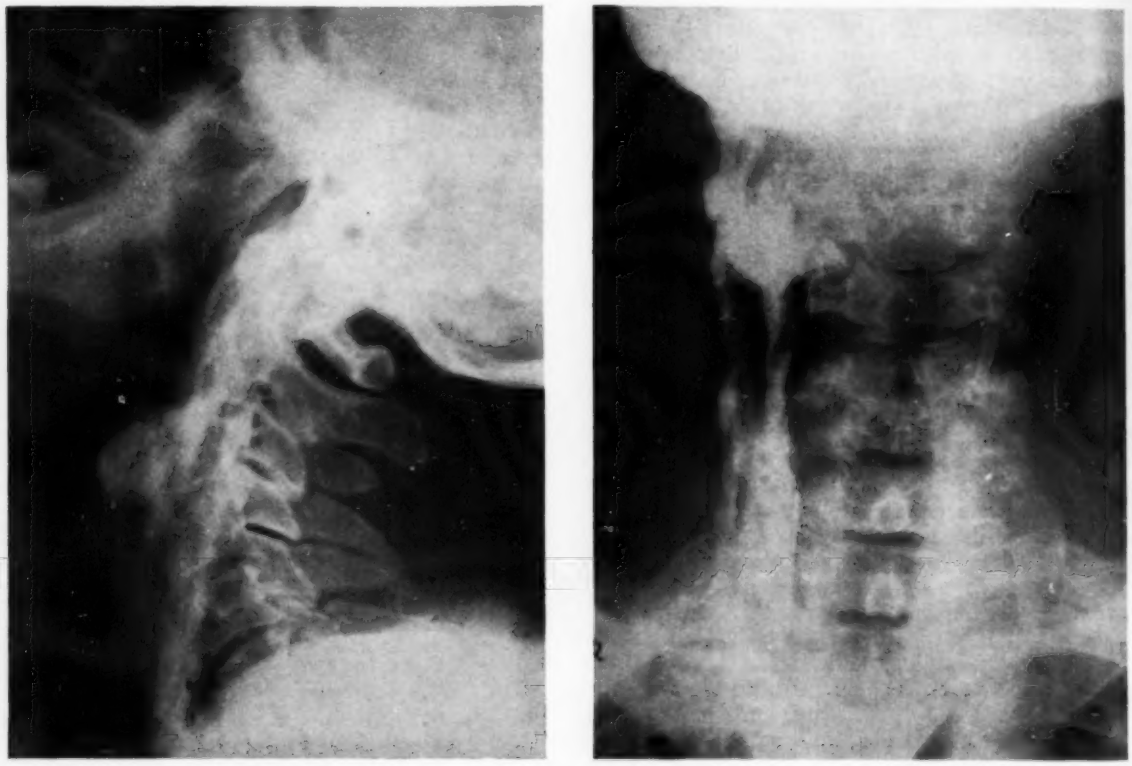


FIG. 781.—*Case* 1. Radiograph of the cervical spine. There is a streaky distribution of contrast medium along the wall of the artery and descending over the apex of the pleura on the right side. At the upper end the mass appears to be calcified. (Photographed by Dr. P. Lehmann.)

Two cases of thorotrastoma of the neck are reported:

CASE REPORTS

Case 1.—Mr. W. O., admitted to the Montreal Neurological Institute on Dec. 2, 1935. No. 1892, aged 45 years.

In October, 1934, the patient fell from a moving car. He struck his head and was rendered momentarily unconscious. During the course of the next year he suffered sixteen major convulsions and was admitted for diagnostic study.

General and neurological examination revealed no abnormality. Bilateral cerebral arteriography was performed and three injections of 15 c.c. each of thorotrast were made into the common carotid arteries. The first injection which was made on the right side was unsuccessful and much of the contrast medium infiltrated the sheath. Subsequent injections were satisfactory. No

abnormality was demonstrated by this method or by ventriculography and he was discharged.

There was no further record of this patient until May, 1946, when he was seen by Dr. Peter Lehmann of Vancouver, B.C., to whom I am indebted for the following observations :—

"Two days after a prostatectomy on March 5, 1946, the patient noticed some hoarseness of his voice after he had been speaking for some time. On examination a

FIG. 782.—*Case* 2. Radiograph taken nine days after arteriography showing thorotrast within the fascial planes of the neck.

bony, hard mass was noticed behind the angle of the jaw. Otorhinological examination showed that he had a paralysis of the right vocal cord. Radiographs of the cervical spine showed what appeared to be a calcified mass, with a streaky distribution of contrast medium extending over the apex of the pleura on the right side. (*Fig.* 781). There were small areas suggestive of calcification within the spleen.

"The patient has been examined on numerous occasions since that date. There has been no alteration in the size of the mass, and there is no evidence of malignant change in the region of the carotid artery. It is the impression of those who have examined him that the mass and the paralysis of the recurrent laryngeal nerve are due to chronic inflammatory reaction rather than to malignant change."

Case 2.—Mrs. F. N., admitted to the Montreal Neurological Institute on May 7, 1948. No. 48-6808. Aged 23 years.

The patient was admitted for investigation of 'lapses', 'ringing in the ears', and 'difficulty in finding the right words'.

General physical and neurological examination was negative. A cerebral arteriogram was performed. The left common carotid artery was exposed and two injections of 8 c.c. of thorotrast were made. During the second injection about 4 c.c. of thorotrast were injected into the peri-adventitial tissues of the artery. The wound was closed without further injection. Ventriculography and craniotomy were performed the following day and a piloid astrocytoma was removed from the left temporal lobe by Wilder Penfield. The patient made an uninterrupted recovery and was given a post-operative course of X-ray therapy amounting to a tumour dose of 5500 r.

Radiographs taken nine days later showed thorotrast within the fascial planes on the left side of the neck (*Fig.* 782). A few tender lymphatic glands were palpable in the posterior triangle of the neck around the ear.

During the course of the following year the patient noticed the presence of a small mass behind the angle of the jaw: this slowly increased in size. She was radiographed again in April, 1950, and Dr. Donald MacRae's report stated that there was an irregular amorphous mass of calcium in the neck, lying below and anterior to the left mastoid process. It measured 4 cm. from before backward, 6 cm. from above down, and 3 cm. from side to side. There was a large, flat extension of calcium medially behind the pharynx and œsophagus and passing to the right of the midline. It extended upwards as far as the arch of the atlas. Two faint streaks of residual thorotrast could be seen passing down the carotid sheath to a little below the thoracic inlet. Diffuse opacification of the liver and spleen was seen.

The patient was reassured and was followed in the tumour clinic. In May, 1953, she was delivered of a normal child.

Re-examination in March, 1954, showed that she had no abnormal neurological findings. She complained, however, that the lump in her neck had increased in size and tenderness and that a small, tender area had recently appeared in the submental region. On examination she was found to have a small, firm mass, located principally behind the angle of the jaw. It was fixed to deeper structures, it did not pulsate, there was no bruit, and it was somewhat tender to pressure. It measured approximately 2 in. vertically by 1 in. laterally and anteroposteriorly. It filled up the entire space behind the angle of the jaw and extended below it.

The carotid artery could be palpated below it in the neck but at the level of the swelling the pulsations could only just be felt and the artery appeared to be encased within the mass. The maximum tenderness was elicited along the line of the artery: the rest of the mass was relatively insensitive. Anteriorly, in the submental region in the midline, a slightly tender node was palpable. This mass was freely movable and the degree of tenderness varied from time to time. There was no hoarseness, and the trachea was central. Examination of the mouth and nasopharynx revealed no abnormality. The liver and spleen were not palpable and there were no enlarged lymph-nodes. Examination of the blood was normal. A radiograph showed no appreciable change in the size of the mass since her previous radiograph in 1950, nor was there much increase in the amount and density of the calcification. The thorotrast within the carotid sheath had not changed in size or position (*Fig.* 783). There was no change in the opacities of the liver or spleen.

DISCUSSION

Diagnosis of these lesions usually presents little difficulty. In most cases there is a history of intracarotid injection, followed by the development of a mass which slowly increases in size. The majority of these lesions appear within a few months of the injection but occasionally development may be long delayed. Struppler (1952), reported a case in which there was a latent period of twenty-one years. In these circumstances the original injection may have been forgotten or overlooked by the patient and an initial diagnosis of malignant growth might be made in virtue of the hard, infiltrating mass that is palpated. Such an error was reported by Jones, 1951, where there was a latent period of fifteen months and

diagnosis was only made when the mass was biopsied prior to radical neck dissection for carcinoma.

A radiograph shows the presence of radiopaque material. In the two cases reported here and in one case reported by Klopp, 1949, it was thought there was calcium present as well as thorotrast, the radiographs showing numerous small particles, as well as streaks of dye.

Diagnosis may be established by the demonstration of radio-activity, the presence of which—even

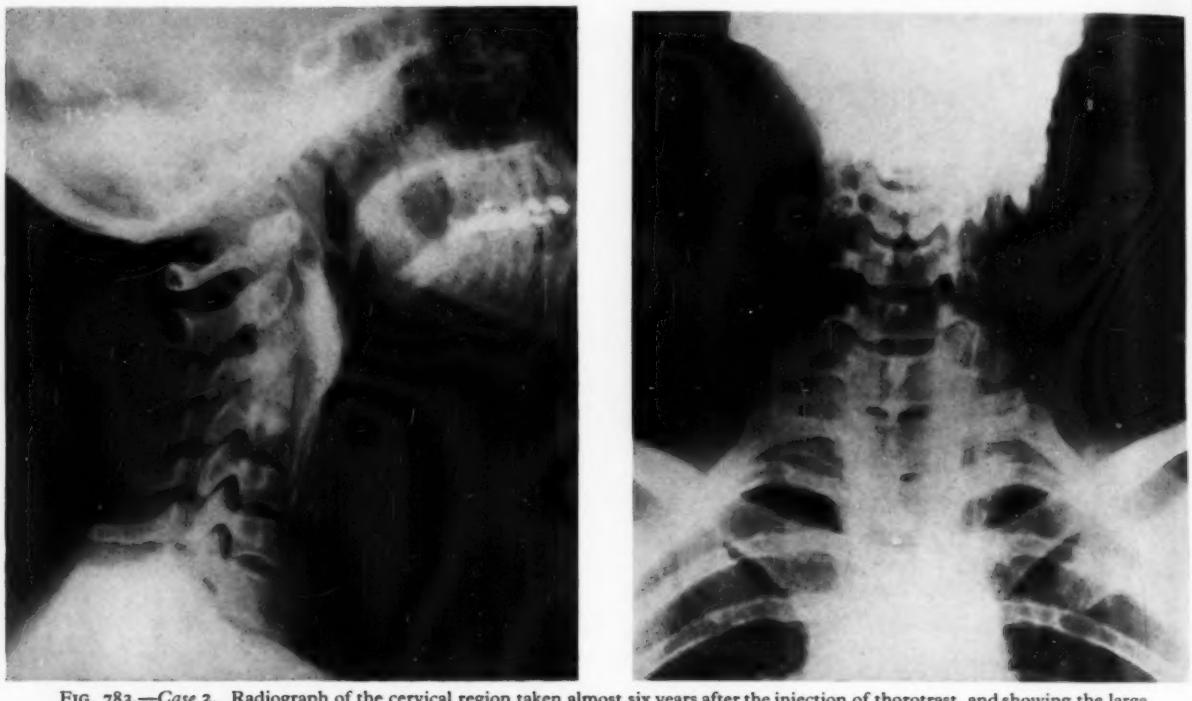


FIG. 783.—*Case* 2. Radiograph of the cervical region taken almost six years after the injection of thorotrast, and showing the large amorphous and apparently calcified mass high up in the neck with residual streaks of dye extending down the carotid sheath.

after the granulomata have been growing for some time—has been demonstrated by Kuntzman, Gross, and Meyer (1950), Fleming and Chase (1936), and Berman (1949), although Ziffren (1940), found no reading on external application of a Geiger-Müller counter and concluded this was due to the filtering action of the skin.

In the case of doubt as to the nature of the lesion, a biopsy may be undertaken.

Histological examination in the early stages shows an increased vascularization and infiltration of the tissues with round and giant cells. Later, there is increasing infiltration with lymphocytes, and the deposition of fibrous tissue. In the late lesions there is a dense fibrosis about numerous foreign body granules which lie within and near the macrophages which abound within the tissues (Peery, 1949; Jones, 1951; Fleming and Chase, 1936). Surrounding muscle, nerve, and vascular structures become involved in the constrictive fibrotic process.

The most satisfactory treatment for these lesions is prophylactic. Thorotrast should be avoided in angiography, unless there are definite contra-indications to the use of other agents. More than usual care must be exerted to prevent a perivascular injection into the tissues. It is probably wiser to expose the artery surgically, as a preliminary, no matter how experienced the arteriographer. Even that, however, may not be satisfactory in certain circumstances, as *Case* 2 demonstrates.

Bradley, 1949, attempted to remove the dye from around the cephalic vein shortly after its injection into the tissues, but without success, since a granuloma developed nevertheless. It seems unlikely that all the irritating fluid can be removed until the thorotrast has been fixed by phagocytic action and a granuloma has begun to develop. It is probable that attempts at early removal of the fluid by incision are of no avail. Furthermore, it is likely that many tissue injections of thorotrast remain asymptomatic and never proceed to granuloma formation at all, or if they do, only to small lesions.

When a mass appears and is noticed by the patient or by the physician, an early decision should be made regarding its removal. Because none has been shown to undergo malignant change in humans, and because of the diffuse fibrous reaction which makes resection very difficult, most authors recommend that no treatment be undertaken. On the other hand, Kuntzman and others (1950), describe 2 cases in which there was a reduction of the blood-supply to the lower limbs, with severe peripheral sequelæ, following the development of a thorotrastoma around the femoral and popliteal arteries. While circulatory difficulties of this nature are not likely to occur from slow occlusion of the carotid artery, there are other structures in the neck that can become involved with equally unhappy results. In *Case* 1 the vagus nerve is involved. McCune (1949), describes a case in which there was dysphagia, dyspnœa, and hoarseness associated with the gradual increase in size of the granuloma. This was resected,

together with the internal jugular vein, the left vagus nerve and the left lobe of the thyroid gland, while the pharynx was so attached to the mass that it was inadvertently opened. The hypoglossal nerve was cut and re-anastomosed. In *Case* 2 the granuloma is slowly increasing in size. No important structures have become involved so far, and although resection has been considered, it has not been undertaken for fear of surgically involving structures which are at present unaffected. It is hoped that this granuloma will stabilize.

Kuntzman and others (1950) used radiotherapy, but without beneficial effect, and it seems that the best treatment for these lesions is prophylactic. Great care should be taken when this drug is being used to prevent the escape of any of it into the perivascular tissues.

SUMMARY

Thorotrast, once popular as a contrast medium in arteriography, has fallen into disfavour because of its possible systemic and local effects. Isolated cases of sarcoma of the liver, fibrosis of the liver, aplastic anæmia, and generalized necrosis of lymph-glands, have been reported in patients who had received thorotrast some years previously. In addition, granulomata around the site of injection have been observed. Two cases of thorotrastoma of the neck are reported, in one of which there was a latent period of ten years between the injection and the first appearance of symptoms. Struppler (1952) reports one case in which there was a latent period of twenty-one years.

Diagnosis may be established by history, radiography, biopsy, or the demonstration of radioactivity. Treatment is conservative, surgery is not advised because of the diffuse fibrosis, and radiotherapy is of no value.

REFERENCES

BERMAN, H. L. (1949), *Arch. Surg., Chicago*, **58**, 67.
BLADES, B., and others (1949), *Ibid.*, **58**, 60.
BRADLEY, T. (1949), *Ibid.*, **58**, 64.
CASSEL, C., RUFFIN, J., REEVES, R., and STODDARD, L. (1951), *Arch. int. Med.*, **88**, 42.
FLEMING, A. J., and CHASE, W. H. (1936), *Surg. Gynec. Obstet.*, **63**, 145.
FOULDS, L. (1939), *Amer. J. Cancer*, **35**, 363.
JACOBSON, L. E., and ROSENBAUM, D. (1938), *Radiology*, **31**, 601.
JONES, R. K. (1951), *J. Neuropath. clin. Neurol.*, **1**, 313.
JONSELL, J. E., and LINDGREN, G. H. (1944), *Radiol. Clin.*, **13**, 201.
KLOPP, C. T. (1949), *Arch. Surg., Chicago*, **58**, 65.
KUNTZMAN, J., GROSS, Ch., and MEYER, J. (1950), *J. Chir. Paris*, **66**, 201.
MCCUNE, W. (1949), *Arch. Surg., Chicago*, **58**, 62.
MACMAHON, H. E., MURPHY, A. S., and BATES, M. I. (1947), *Amer. J. Path.*, **23**, 585.
MORA, J. M. (1940), *J. Amer. med. Ass.*, **115**, 363.
NAEGELI, T. L., and LAUCHE, A. (1933), *Klin. Wschr.*, **12**, 1730.
PEERY, T. M. (1949), *Arch. Surg., Chicago*, **58**, 66.
SELBIE, F. R. (1936), *Lancet*, **2**, 847.
SPIER, J. J., CLUFF, L. E., and URRY, W. D. (1947), *J. Lab. clin. Med.*, **32**, 47.
STRUPPLER, A. (1952), *Dtsch. med. Wschr.*, **77**, 311.
ZIFFREN, S. E. (1940), *Radiology*, **34**, 171.

PERFORATED PEPTIC ULCER: THE IMMEDIATE AND LONG-TERM SEQUELÆ

BY A. TOM MATHESON
ROYAL UNITED HOSPITAL, BATH

INTRODUCTION

THE immediate treatment of perforated peptic ulcer is under constant review and discussion in the literature. By comparison, the long-term sequelæ of a treated perforation have received scant serious consideration. Stimulated by an impression that the outlook for such patients differed materially from that of other cases of peptic ulcer, a review of a series of perforations was undertaken.

In all 115 cases were reviewed. The survey covers all perforated gastric and duodenal ulcers, other than proven malignant ulcers, admitted to the Royal United Hospital, Bath, during the years 1945 to 1950 inclusive (96 in number), and to St. Martin's Hospital, Bath, during 1949 (19 in number). The St. Martin's cases were not selected; 1949 was the earliest full year during which all case histories were available.

Except where the general condition prevented any surgery, all cases were treated by simple suture of the perforation, with peritoneal cavity drainage where indicated. Only one primary partial gastrectomy was performed, and that for a second perforation.

Twenty-three patients died in the hospitals. The 92 survivors have been followed up between 4 and 10 years; in all but 14 cases the survey may be regarded as full and complete.

CLASSIFICATION

It became apparent that the cases fell naturally into several distinct groups, viz.—

1. Deaths due to perforation: 23 cases—19 were 'immediate', i.e., within five days of perforation; 4 were 'secondary' to post-operative complications.
2. Delayed deaths: 12 cases—i.e., patients deceased from any cause after discharge from hospital.
3. Re-perforations: 10 cases.
4. Gastrectomy or gastrojejunostomy subsequently performed: 30 cases.
5. Patients who were urged to have a further operation, but who refused it for any reason: 8 cases.
6. Those not classifiable under the above headings: 46 cases.

Obviously there is considerable overlap in this rough classification, e.g., one patient refused gastrectomy after a first perforation, had a second perforation and died later of an unrelated cause.

Table I.— DEATHS DUE TO PERFORATION

CASE NO.	AGE	DAYS SURVIVAL	ULCER HISTORY	ULCER SITE AT OPERATION	CAUSE OF DEATH AS CERTIFIED
82	54	D.O.A.	6 mth.	No operation	Perforated duodenal ulcer ; ' shock '
109	48	0	' Years '	Cardiac massage only	Cardiac arrest ; perforated peptic ulcer
78	57	0	3 wk.	No operation	Cirrhosis ; anæmia ; perforated gastric ulcer
79	62	0	' Years '	No operation	Perforated duodenal ulcer ; general peritonitis
15	65	0	3 mth.	No operation	Perforated gastric ulcer ; general peritonitis
48	71	0	3 yr.	No operation	Perforated gastric ulcer ; general peritonitis
80	76	0	20 yr.	No operation	Perforated duodenal ulcer ; general peritonitis
86	77	1	Unknown	No operation	Perforated duodenal ulcer ; diabetes ; arteriosclerosis
8	56	0	3 mth.	Gastric	Morphine anaphylaxis
4	70	0	Unknown	Duodenal	General peritonitis (no autopsy)
110	57	1	' Years '	Gastric	Acute congestive cardiac failure
105	60	1	Unknown	Duodenal	Cardiac arrest on table (temporary revival)
106	67	1	10 yr.	Duodenal	Cardiovascular disease ; 2 perforated duodenal ulcers
81	66	1	' Years '	Gastric	General peritonitis
10	73	2	' Years '	Duodenal	Myocardial infarct
49	70	2	' Years '	Gastric	General peritonitis (no autopsy)
101	83	2	Unknown	Duodenal	General peritonitis (no autopsy)
23	60	4	' Years '	Duodenal	Peritonitis ; ileus
71	63	5	' Years '	Gastric	Peritonitis ; pneumonia ; pulmonary œdema
55	64	12	' Years '	Duodenal	Pelvic peritonitis
76	52	16	17 yr.	Gastric	Arteriosclerosis ; bronchiectasis
66	73	18	5 yr.	Gastric	Melæna ; bronchopneumonia
34	65	26	3 yr.	Duodenal	Subphrenic abscess ; empyema

1. Deaths due to Perforation (*Table I*).— These 23 cases include all deaths from perforated peptic ulcer, regardless of circumstances. Thus 1 patient was dead on admission to hospital, 1 died of cardiac arrest during induction of anæsthesia, 2 died in non-surgical wards while under treatment for other conditions, and 4 more were quite unfit for any surgery on admission and died within twenty-four hours. The remaining 15 patients were treated by a simple closure of the perforation, with or without peritoneal drainage.

Table II.—AGE DISTRIBUTION

AGE AT PERFORATION	SUCCESSFUL GASTRECTOMY		DEATH AFTER GASTRECTOMY		GROUP (F) CASES*		TOTAL SURVIVORS	
	D.U.	G.U.	D.U.	G.U.	D.U.	G.U.	D.U.	G.U.
18–29	3	0	0	0	2	0	6	0
30–39	3	0	0	0	7	3	11	3
40–49	12	0	0	1	10	2	25	4
50–59	4	1	1	0	8	2	16	4
60–69	2	0	2	0	7	2	14	4
70–79	1	0	0	0	0	1	2	1
	25	1	3	1	34	10	74	16

* (Site of ulcer doubtful in 2 patients, aged 43 and 67.)

In 9 of these cases the ulcer which perforated was gastric ; in 13 it was duodenal and in 1 case the site was not determined. This 40 per cent incidence of gastric ulcer is far higher than in non-fatal perforations.

Classification on a basis of age is of interest :—

1 aged 48.
6 aged 50 to 59.
8 aged 60 to 69.
7 aged 70 to 79.
1 aged 83.

By comparison (*Table II*), in this series only 3 patients over 70 years of age survived the perforation. Consequently a perforated peptic ulcer may be regarded as an important cause of death in the aged, and as lethal at ages over 70.

Further consideration of *Table I* reveals the frequency of an unfortunate or severe systemic factor in the younger deaths. It also emphasizes the very long histories of symptoms of peptic ulcer in the majority, some of whom had received prolonged medical treatment for a known ulcer.

2. Delayed Deaths (*Table III*).—No less than 12 patients—13 per cent of the survivors—were

Table III.— DELAYED DEATHS

CASE NO.	AGE AT PERFORATION	ULCER SITE	DIED— TIME	ULCER HISTORY	SEQUELÆ TO PERFORATION	CAUSE OF DEATH
18	35	D.	6 yr.	6 yr.	Not known	Road accident
7	52	G.	4½ yr.	20 yr.	Not known	Emphysema ; cardiac failure
26	55	G.	6 yr.	4 yr.	Not known	Coronary thrombosis
88	55	D.	4 yr.	' Years '	Persistent dyspepsia	Bronchiectasis ; cor pulmonale
111	59	D.	2½ yr.	15 yr.	Pain 2 yr. later	Carcinoma of colon
1	59	D.	5½ yr.	2 wk.	Nil	' Chest troubles '
3	60	D.	8 yr.	26 yr.	Nil	Congestive cardiac failure
25	61	G.	5 mth.	4 yr.	Pyloric obstruction – 4 mth.	Carcinoma gall-bladder ; subphrenic abscess
14	62	D.	3 mth.	20 yr.	Nil	Congestive cardiac failure ; pulmonary embolus
31	68	Not known	6½ yr.	3 yr.	Dyspepsia – 1 yr. later	Tabes dorsalis
100	70	G.	1 yr.	' Years '	Nil	Congestive cardiac failure
83	61	D. (2nd)	2½ yr.	20 yr.	Gastrectomy 4 mth. later	Bronchitis ; cardiac failure

reported as deceased by a reliable source at the time of the survey. In only one of this group had a partial gastrectomy been performed subsequent to perforation. The average age of death was 62 years and patients died between 3 months and 8 years after perforation. In no case could death be attributed directly to the ulcer, its treatment or complications.

Table IV.—RE-PERFORATIONS

Case No.	Ulcer Site	Ulcer History	Age, First Perforation	Sequelæ to First Perforation	Interval	Sequelæ to Second Perforation
3	D.	Indigestion 26 yr.	60	Pain 6 mth. later; refused gastrectomy	7 yr.	Died 6 mth. later of pneumonia and empyema
20	D.	Indigestion 2 mth.	42	No symptoms	1½ yr.	Relapse 4 yr. later—gastrectomy performed—well since
43	D.	Indigestion 6 yr.	35	Relapse after 4 mth.	1 yr.	Relapse 3 mth. later—gastrectomy performed—well since
33	D.	Indigestion for ' years '	38	Relapse after 2 yr.	3½ yr.	Immediate gastrectomy—well since
63	D.	Indigestion 25 yr.	46	Relapse after 6 mth.	9 mth.	Emergency gastrectomy for bleeding 2 mth. later—died
67	D.	' Many years '	49	Relapse stat.; hæmatemesis 6 yr. later	7 yr.	Relapse 2 yr. later—gastro-jejunostomy—stomal ulcer—gastrectomy age 59—well since
97	D.	Nil	18	Nil	2 yr.	Barium meal 3 yr. later showed D. ulcer
108	D.	Nil	51	Relapse few weeks before second perforation	3 yr.	Immediate relapse—gastrectomy 4 mth. later—well since
117	D.	Indigestion 2 yr.	24	Relapse after 6 mth.	4½ yr.	Gastrectomy 2 mth. later—well since
83		Indigestion 20 yr.	58	Relapse—time uncertain	3 yr.	Gastrectomy 2 mth. later—died 2 yr. thereafter of cardiac failure

3. Re-perforations (*Table IV*).—In each case this diagnosis was substantiated from operation notes. The 10 patients represent 11 per cent of the survivors—a far higher figure than might be anticipated. The age distribution, and the fact that all were re-perforations of duodenal ulcers, suggest that the younger subject who has had one duodenal perforation carries fair risk of a second.

The youngest patient in this group is interesting in that both perforations were neither preceded nor followed by significant symptoms. However, a barium meal now (three years after the second perforation) shows a small ulcer crater.

4 Further Operation performed.—This group of 30 patients represents nearly one-third of the survivors. To them one may add 7 of the 8 patients discussed in group 5, making 41 per cent in all. Further, the surgical attitude of the two hospitals is conservative in that gastrectomy is avoided as far as possible in people below the age of 40. Three such younger patients are still under strict medical treatment with a view to partial gastrectomy at a later age. Thus it is fair to state that nearly one half of all perforated peptic ulcers will require further surgery at some later date.

The age distribution of this group and of group 5 is compared in *Table II*. The similarity is evident.

Table V reveals the chief symptom for which further operation was required and the period of time after perforation when significant symptoms first occurred. The high incidence of early relapse—more than half within one year—and of pyloric obstruction, may be emphasized.

Table V.—RELATES THE TIME OF THE FIRST REPORTED RELAPSE AFTER PERFORATION TO THE CHIEF SYMPTOM REQUIRING FURTHER SURGERY (GASTRECTOMY OR GASTROJEJUNOSTOMY)

	Hæmatemesis	Melæna	Further Perforation	Pain	Pyloric Obstruction	Total
0 to 3 mth.	0	2	0	3	5 (2)*	10
3 to 6 mth.	0	0	0	2	1	3
6 to 12 mth.	1 (1)	0	1	2	0	4
1 to 2 yr.	2 (1)	0	0	1	1	4
2 to 3 yr.	0	0	1	0	3	4
3 to 4 yr.	0	0	2	0	1	3
More than 4 yr.	0	1	1	0	0	2
Total	3	3	5	8	11	30

* Numbers in parentheses indicate partial gastrectomy deaths.

In this group the perforation was duodenal in all but two patients.

Two cases of gastro-enterostomy are included with the 28 partial gastrectomies. In one patient it was performed as an initial operation for severe pyloric obstruction, but she remained symptom-free after it. The other patient was a man of 74 who had dense perigastric adhesions, making gastrectomy technically difficult.

There were 4 deaths after partial gastrectomy but in 3 of these cases the circumstances were unusual. Thus one patient had refused operation three years previously and died after a difficult transthoracic gastrectomy, from pulmonary embolism. Two patients required emergency gastrectomy for severe hæmatemesis and died of pulmonary embolism and a

duodenal stump leak. (The third of the 3 emergency gastrectomies for bleeding survived the operation.) The fourth death was the only fatality following a planned abdominal gastrectomy and was due to a duodenal stump leakage.

The 26 successful cases have all been followed up to date. One patient died 2 years after gastrectomy from congestive cardiac failure. One is severely afflicted by renal tuberculosis which was present but inactive before operation. Two patients developed stomal ulcers which healed under stringent medical treatment. Only 1 man has severe dumping symptoms and is currently under review. The remainder have had no significant symptoms since operation.

Almost an invariable feature of this group was the chronicity of the ulcer at the time of perforation, as revealed by a very long (2 to 30 years) preceding history of ulcer symptoms and/or the finding of a chronic ulcer crater at the operation for perforation.

Certain technical points are worthy of note. Firstly, while the size of the actual perforation was described frequently in operation notes, its nature was usually ignored. Obviously a large, punched-out perforation has a significance different from that of a small hole at the base of a large, chronic crater. Secondly, where there was doubt at the initial closure whether a perforation was gastric, pyloric, or duodenal in nature, in every case a chronic duodenal ulcer was present at later gastrectomy. Recently this fact has been established in 3 cases to date by the insinuation of a finger-tip into equivocally situated perforations; in all 3 the pyloric sphincter was palpable definitely proximal to the perforation.

By far the commonest site of duodenal perforation was anterior, into the greater sac. However, when gastrectomy was performed at a later date, the operation notes (in such known anterior perforations) frequently stressed a chronic, adherent ulcer; and more often than not it was penetrating posteriorly, into the pancreas. It thus appears that: (*a*) after perforation an ulcer proceeds to penetration and fibrosis, and (*b*) a second, posterior, chronic ulcer must follow an anterior perforation in some cases.

It was also noted that in no case was a Billroth type partial gastrectomy performed, despite a strong preference for it by some of the surgeons.

5. Gastrectomy advised, but refused.—These 8 patients form a small but interesting subsection. *Table VI* reveals that 3 are now dead, 2 cannot (or will not) be traced, 3 are still plagued by severe ulcer symptoms and resist further advice regarding gastrectomy, given by general practitioners. These patients may then be regarded as having refused further surgical treatment at their own perils.

Table VI.— GASTRECTOMY ADVISED, BUT REFUSED

CASE NO.	AGE AT PERFORATION	ULCER SITE	ULCER HISTORY	RELAPSE TYPE/TIME	ADVISED OPERATION — TIME	SEQUELÆ TO REFUSAL
3	60	D.	26 yr.	Pain, 6 mth.	5 yr. and 6 yr.	Re-perforation 7½ yr. later and died 6 mth. thereafter
13	49	G.	1½ yr.	Pain, 3 mth.	3 mth.	Cannot be traced
16	54	G.	'Years'	Obstruction, 2 wk.	2 wk.	Died 3 yr. later after gastrectomy via chest
31	68	D.	4 yr.	Pain, immediate	2 yr.	Died after 6½ yr. from tabes dorsalis
53	49	D.	6 yr.	Pain and melæna, 3½ and 7 yr.	3½ yr. and 7 yr.	Still greatly disabled by dyspepsia
62	41	D.	3 yr.	Pain and melæna, 2 mth.	4 mth.	Cannot be traced
65	46	D.	2 yr.	Obstruction and pain, 3 mth.	10 mth.	Still has severe dyspepsia
99	65	D.	20 yr.	Obstruction and pain, 2½ and 5 yr.	5 yr.	Complete pyloric obstruction after 9 yr.; gastrojejunostomy

The reason for refusal of further surgery was basically personal in every case; additional factors were fibrillation, chronic hypertension, and chronic empyema in cases 16, 3, and 99 respectively.

6. Remaining Cases.—These are 46 in all. The age distribution is shown in *Table II*. Thirty-four of the perforations were duodenal, 10 were gastric, and only 2 were doubtful in situation.

The 37 patients in whom an adequate follow-up was possible present a variety of clinical pictures. Certainly 5 cases must be regarded as being acute perforations, the stringent criteria being: no significant preceding history, a punched-out perforation, and no subsequent symptoms. In all these cases the perforation was duodenal (as also in the young man with 2 acute perforations, already mentioned); their ages were 69, 69, 54, 52, and 31.

Four patients claimed a complete cure following the perforation, i.e., a prolonged significant history preceded the perforation but no symptoms whatever have recurred despite a normal diet without medicines. Three were gastric perforations and 1 was duodenal; their ages were 58, 47, 46 and 39.

Examination confirmed the infrequency of herniation through the wound following closure of a perforation. It was found in only 2 patients, both of whom had had a wound dehiscence after operation.

The results varied in the remaining patients. Some have been remarkably better, some considerably worse, and others unchanged since the perforation. Frequently they minimized their symptoms and, in a few cases thus checked, the general practitioner reported more trouble than the patient himself admitted. The general impressions are:—

a. The younger patients and the duodenal ulcers have more trouble after perforation than the older or gastric subjects.

b. Retirement from manual labour due to age; financial means providing adequate leisure; intercurrent disease limiting activity; extraction of carious teeth or stumps—these were noted repeatedly as factors toning down the activity of the ulcer symptoms.

c. A fair proportion of this group would have benefited in the long run from partial gastrectomy after their first significant relapse.

d. An early follow-up interrogation is misleading due to the frequency of a remission of all symptoms after perforation.

e. Likewise, an early check barium meal is of little value; in the average case the scar produces deformity whereas re-ulceration probably has not yet recurred.

f. Comparing this entire group with those who actually came to further surgery, and those who did well with those who did less well after perforation, we can determine no further factor or group of factors, providing predictability.

Nine of the 46 patients cannot be traced or cannot be coaxed to come up for examination. While it is known that some of these are alive and active, available data are inadequate. Considering that the review covers the terminal war year and the immediate post-war period, and that the hospitals serve a semi-rural area with migratory labour, it is not regarded as surprising or disappointing.

Perforations in Females (*Table VII*).—These 10 cases constitute 8 per cent of the entire series. However, all the 6 females aged over 60 succumbed to the perforation, providing 22 per cent of all fatalities.

None of the 4 survivors, their average age being 43, progressed satisfactorily after perforation. Thus 1 died 3 years later after a transthoracic gastrectomy; 2 required further surgery for pyloric obstruction; the fourth, now aged 31, remains under strict medical treatment for persistent ulcer symptoms.

Table VII.— PERFORATIONS IN FEMALES

CASE NO.	AGE AT PERFORATION	ULCER HISTORY	ULCER SITE	SEQUELÆ TO PERFORATION
47	25	3 yr.	D.	Remission 2 yr.; severe dyspepsia thereafter; strict medical treatment
36	40	9 yr.	D.	Pyloric obstruction after 3 yr.; gastrectomy 6 mth. later; well since
107	54	1 yr.	D.	Pyloric obstruction after 6 mth.; gastro-enterostomy 1 mth. later; well since
16	54	'Years'	G.	Refused operation 15 mth. later; died 3 yr. later from embolism after gastrectomy via chest
55	64	'Years'	D.	Died twelfth day—pelvic peritonitis
78	65	3 mth.	G.	Died day of admission; no operation; autopsy: cirrhosis, anæmia; general peritonitis
15	65	3 mth.	G.	Died day of admission; no operation; autopsy: general peritonitis
49	70	'Years'	G.	Died 2 days after closure of perforation; no autopsy
80	76	20 yr.	D.	Died in medical ward; no operation; autopsy: general peritonitis
86	77	Nil	D.	Died day after admission; no operation; autopsy: advanced cardio-vascular disease; general peritonitis

CONCLUSIONS AND SUMMARY

1. A series of 115 perforated peptic ulcers, treated by simple suture where possible, is reviewed. The 92 patients who survived the perforation or its immediate complications have been followed up between 4 and 10 years.

2. Gastric perforations were, proportionately, more frequently fatal than were duodenal. Age was a most important factor influencing the immediate fatalities. A perforation was always lethal in females aged over 60, and usually so in males aged over 70. In younger subjects a fatal issue was often associated with systemic disease.

3. Of the survivors, 13 per cent had died subsequently, all from unrelated causes and at an average age of 62 years.

4. The incidence of re-perforation was unduly high, viz., 11 per cent. In every case the causative ulcer was duodenal, and the age incidence was notably younger than the average.

5. Further operation (partial gastrectomy where possible) was performed in one third of the survivors. All but 2 of these 30 patients had had duodenal perforations. A group which refused the advice of further operation is discussed. It is estimated that one half of all cases of perforated peptic ulcer would require definitive surgery subsequently.

6. The overall mortality-rate for gastrectomy was 13 per cent, but 3 of the 4 fatalities occurred under special circumstances; only 1 patient died after a planned trans-abdominal gastrectomy. The remaining patients have done extremely well, on the whole.

7. An early relapse after perforation was one important factor suggesting the necessity for further operation; and pyloric obstruction was the commonest complication for which partial gastrectomy was performed.

8. It appeared that an ulcer which had once perforated proceeded to fibrosis and penetration at an accelerated rate. Further, a posteriorly penetrating ulcer not infrequently followed the treatment of an anterior duodenal perforation.

9. Four patients, 3 of whom had ulcers, were cured symptomatically by the perforation.

10. The acute perforation is a clinically distinct entity and was observed in a few duodenal perforations of all ages.

11. The course of the individual case after perforation is unpredictable. Factors of apparent importance in this respect are mentioned.

12. Perforations in women were more serious than those in men; all 6 females aged over 60 years succumbed and the 4 younger ones did uniformly poorly after perforation.

Appreciation is expressed to the Consultant Surgeons serving both hospitals for permission to use their clinical records; to the Theatre Sisters, Records' Officers, and Medical Officer of Health, Bath, for assistance in compiling the data; and to Mr. F. D. Murphy and Mr. C. E. Kindersley for encouragement and helpful advice.

A CASE OF SPONTANEOUS LEFT URETEROCOLONIC FISTULA ASSOCIATED WITH AN ABSCESS IN THE LEFT LOIN AND FÆCAL FISTULA

By A. H. HAYSOM

TRANSITIONAL SURGICAL REGISTRAR, WINCHESTER GROUP OF HOSPITALS

SPONTANEOUS ureterocolonic fistula is a very rare condition and usually due to an untreated perinephric abscess (Gow, 1951). A second, and even rarer cause, is a calculous pyonephrosis of either tuberculous or pyogenic origin (Shucksmith, 1941).

This case presents an example of the latter type and was due to an impacted stone in the left ureter at the level of the pelvic brim; there was also a symptomless, left-sided calculous pyonephrosis. Associated with the site of this fistula was a perirureteric abscess that had caused a perforation of the pelvic colon; it was this perforation that had produced the collection of pus above the left iliac crest, and when drained revealed the fæcal fistula.

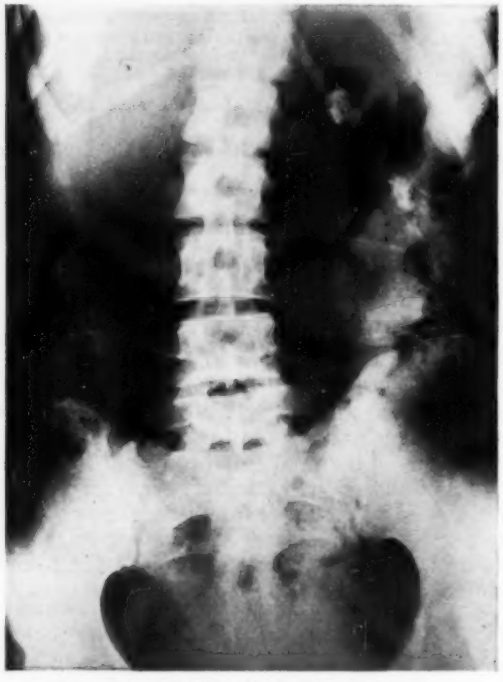


FIG. 784.—Straight radiograph of abdomen.

CASE REPORT

HISTORY.—Miss F., aged 29, attended Medical Outpatients in July, 1951, complaining of pain in the left loin.

Her medical history recalled that three years previously she had had a normal confinement, and up to that time had been perfectly well. Two and a half years ago (six months after parturition) she complained of pain in the left loin, radiating round to the left iliac fossa, and down to the left groin; a swelling was present in this loin, that disappeared gradually over the course of three to four weeks, following rest in bed. There was no nausea or vomiting; her bowels were perfectly normal, and she had no frequency of micturition or hæmaturia. During the past two years she had had three similar attacks, and with each successive attack the pain had been slightly more severe than the previous one; but none had lasted for more than two months. They had occurred at approximately six-monthly intervals, and all responded to the same treatment: rest in bed.

Three weeks prior to her attendance at Out-patients, general malaise heralded the onset of the present attack, which was far more severe than any previous one, and for the first time was accompanied by blood in the urine, which lasted for two days. The pain, although very severe, was not colicky in nature and became worse when lying on her left side. She had no dysuria or frequency of micturition; no nausea or vomiting; bowel history remained unchanged, and like the menses, was normal and regular for her. The swelling in her left loin appeared as with previous attacks; but on this occasion increased very rapidly in size, and the skin over it became red and tender. There was no history of a cough or night sweats, and her appetite was good although she had lost approximately 2 st. in weight over the past two years.

Her past history conveyed no evidence of any inflammatory disease of the urinary tract, or of trauma to the kidney area.

ON EXAMINATION.—The examination revealed a very nervous woman, with a furred but moist tongue; the fauces were clear and teeth good. There was no clubbing of the fingers, or enlargement of the lymphatic glands. The central nervous, respiratory, and cardiovascular systems showed no abnormal physical signs. The pulse was 100 and the B.P. 120/80. Abdominally, there was a large mass in the left loin extending round to the left iliac fossa; this was very hard, except for a small part over the iliac crest which was much softer in consistency, and the skin over this area was reddened. There was no guarding or rigidity of the abdominal wall. The liver and spleen were not enlarged, and no other mass was palpated in the abdominal cavity. Rectal and vaginal examinations showed that the pelvis contained no abnormality.

The provisional diagnosis of a perinephric abscess was made, and the patient admitted to hospital as an emergency. The following investigations were then carried out:—

INVESTIGATIONS.—

Urine.—A catheter specimen of urine which was acid to litmus and with specific gravity of 1020, contained some pus and albumin, but no casts or crystals; it grew coliform organisms on culture. Like a 24-hour specimen it was negative for Koch's bacillus, both on direct culture and guinea-pig inoculation.

Blood.—The hæmoglobin was 60 per cent, the packed cell volume 31 and the blood sedimentation rate (Wintrobe's method) was 23 mm. in 1 hour. The white-cell count revealed 13,700 ccm.; neutrophils 80 per cent and lymphocytes 20 per cent. The Wassermann reaction was negative.

Radiograph.—The radiograph of her chest exhibited normal shadows. A straight radiograph of the abdomen showed a calcified shadow in the left hypochondrium, which had the appearance of a left renal calculus (*Fig.* 784). An intravenous pyelogram showed that the right urinary tract had outlined normally, but no excretion could be seen on the left side. The calcified shadow in the left hypochondrium persisted and a second small shadow outlined on this side, which showed between the lumbar

transverse processes of 3 to 5; this was thought to be in the ureter. A repeat pyelogram confirmed the presence of these two shadows on the left side, and the absence of function of the left kidney. (*Fig.* 785.)

TREATMENT.—The patient was given a six day course of potassium citrate and sulphatriad. Following this a cystoscopy was performed.

CYSTOSCOPY (J. R. and A. H. H.).—The cystoscope passed easily, and the small quantity of residual urine was slightly cloudy. Some pus was seen in the bladder, the mucosa of which appeared to be normal. The right ureteric orifice looked normal and the efflux was clear; but the left was a little red and no urine was seen to escape from it. A No. 9 ureteric catheter travelled easily up the right ureter, but could not be passed beyond 13 cm. up the left side. Indigo carmine appeared five minutes after intravenous injection from the right ureter, but none was seen to escape from the left side up to a period of 1 hour.

FIG. 785.—Intravenous pyelogram showing shadows on the left side and non-functioning left kidney.

A retrograde pyelogram outlined a normal right urinary tract, while the injection of a contrast medium into the left ureteric catheter partly outlined the sigmoid colon, indicating a ureterocolonic fistula. The left urinary tract above this point could not be outlined. (*Fig.* 786.)

A few days following this examination, the mass in her left loin increased in size and became fluctuant. It was therefore decided to drain this abscess surgically. One pint of blood was given pre-operatively.

AT OPERATION (J. R.).—July 19, 1951. *Anæsthetic*—pentothal–flaxedil–N_2O and O_2. Through an incision in the left loin the abscess was opened. A small quantity of pus was obtained, together with some blood-clot and necrotic material. The abscess cavity was digitally explored and found to extend backwards to the psoas muscle; forwards past the iliac crest to the anterior abdominal wall; above, it reached to the lower pole of the left kidney and below, it passed down over the brim of the pelvis into the extra-pelvic tissues. This cavity was drained and the pus on culture was found to be sterile both for aerobic and anaerobic organisms.

Following the drainage of this abscess in the loin there was a marked improvement in the patient's general condition. Two days after the operation, however, she was found to have a fæcal discharge through the incision wound. This persisted, and after a few weeks it was decided to carry out some further investigations prior to advising further treatment.

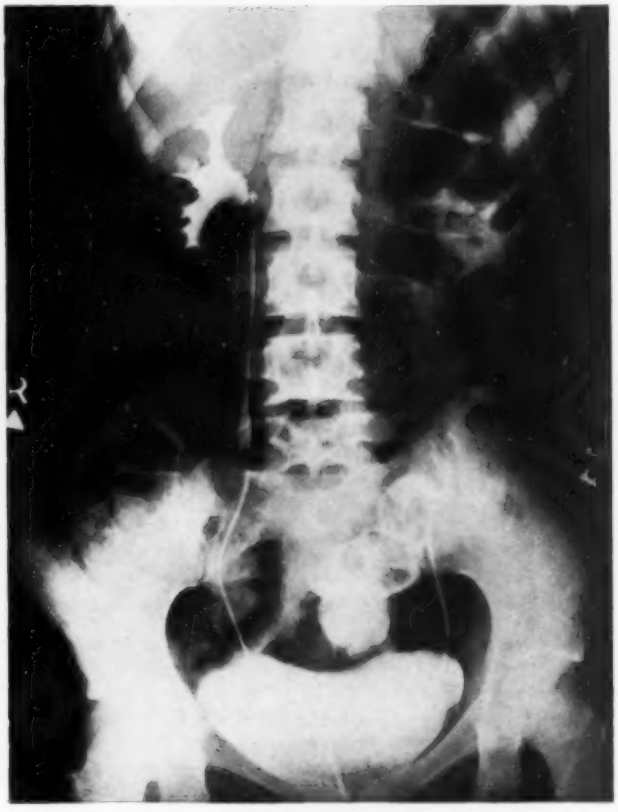


FIG. 786.—Retrograde pyelogram showing filling of the sigmoid colon on the left side.

FURTHER INVESTIGATIONS.—

Radiograph.—A barium enema. This showed a long loop of pelvic colon, which for the most part exhibited a normal mucosal pattern, but in the left iliac fossa there were one or two barium shadows which lay superimposed on this normal pattern and suggested the possibility of a fistula. A follow-up of this examination revealed that the barium had completely cleared from the bowel, and there were no residue areas of barium seen extramurally. This examination, therefore, produced no conclusive findings.

Indigo carmine (5 c.c.) was injected intravenously; this stained the urine blue but no similar coloured discharge was seen to exude from the wound.

A barium solution injected into the wound showed that there was a direct communication with the colon, the latter partly filling with opaque material. It was also noted that the hydronephrotic left urinary tract was clearly outlined with air; and that a small quantity of barium had entered the left ureter from the sigmoid loop. (*Fig.* 787.)

These investigations revealed a fistulous communication between the left ureter and the pelvic colon. In addition, a fæcal fistula between the pelvic colon and the site of the abscess incision could be clearly seen.

The general condition of the patient had remained satisfactory; there were no signs of the fistula closing or of the wound healing. It was therefore decided that the left kidney, ureter, and fistula area should be explored. Following a pre-operative course of succinyl sulphathiazole, streptomycin washouts through the fistula and two pints of blood, she underwent a further operation.

AT OPERATION (A. H. H.).—Aug. 27, 1951. *Anæsthetic*—pentothal–flaxedil-N_2O and O_2. Through a left paramedian incision, extended in the form of a T below the left costal margin, the left side of the abdominal

FIG. 787.—Barium into sinus demonstrating fistula and barium travelling up left ureter.

FIG. 788.—Calculus removed from fistulous track between ureter and colon.

cavity was explored. The site of the ureterocolonic fistula was found at the brim of the pelvis, and the fistulous track, between the colon and the abscess incision, could be felt behind the pelvic colon.

The descending colon was mobilized, and retracted forwards and medially to expose the left kidney. This area was remarkably free from adhesions, except at the lower pole of the kidney, which was firmly fixed by dense

FIG. 789.—Removed kidney cut in half.

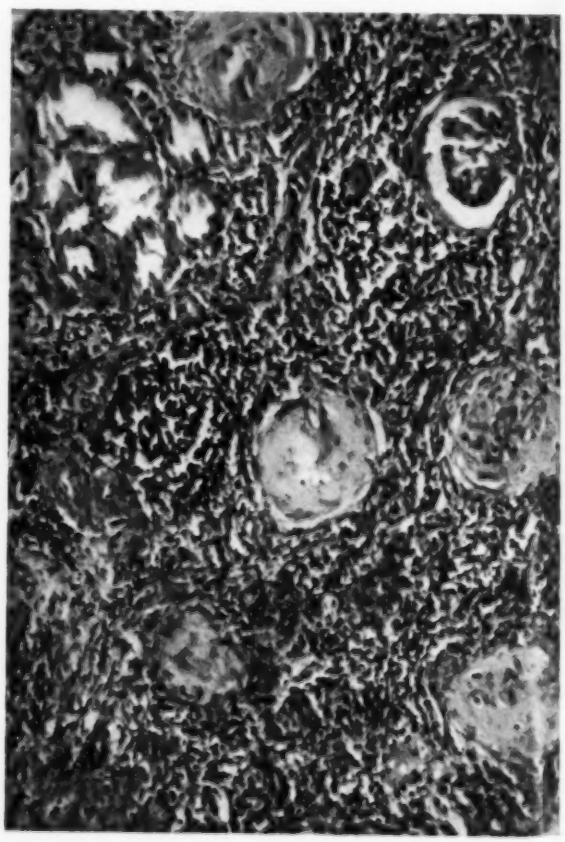


FIG. 790. - Section through kidney. (× 40.)

adhesions to the surrounding perinephric tissues. The ureter was next traced from its communication with the colon up to the pelvis of the kidney. The extra-ureteric calculus, seen on the radiograph (*Fig.* 784), was found and removed. It was lying just outside the ureter posteriorly at the site of the ureterocolonic and colic fistulæ. (*Fig.* 788.) An extracapsular nephrectomy was performed, ligating the artery and vein separately. The ureter was then separated from the bowel, and the perforation in the latter closed with two layers of interrupted catgut sutures. Behind the colon, and extending down into the pelvis, was a large abscess cavity. This had a thick fibrotic track connecting it to the surface posteriorly through the old incision wound. This cavity and sinus track were curetted. The colon was replaced to its anatomical position and the abdomen closed. Two large rubber drains were inserted into the site of the abscess cavity, one through a stab wound just below the most lateral point of the transverse portion of the T incision, and the other through the original old wound in the loin.

This intra-abdominal examination at once made apparent the sequence of events. A fistula had formed between the left ureter and the pelvic colon, secondary to a neglected impacted calculus in the ureter at the level of the pelvic brim. A peri-ureteric abscess had then formed around this portion of the ureter, and later ruptured into the pelvic colon, giving rise to a fæcal fistula. This in turn had given rise to a lumbar abscess which, when drained, revealed the fæcal fistula. (*See Fig.* 791.)

PATHOLOGY.—The histological examination of the specimen removed showed :—

Macroscopical.—A kidney measuring about 10·5 × 5·0 cm.; it is coarsely lobulated and the surface is granular.

On Section.—The cortex and medulla are much reduced in thickness by hydronephrosis. At the upper pole in one of the large calices is a yellow mass of calcarious material. In another calix is a collection of greenish yellow pus.

The upper part of the ureter contains more of this calcarious material.

Microscopical.—The picture is that of an acute-on-chronic pyelitis, with considerable inflammatory thickening of the pelvic lining, extending as an acute, pyogenic inflammation up the renal tubules. From these it is actively spreading into the interstitial tissue, forming multiple abscesses.

All this is superimposed on a long-standing chronic nephrosclerosis, in whole areas of which the glomeruli are little more than fibrous scars. Even where they are less affected, there is still a good deal of periglomerular ischæmic fibrosis.

A section of ureter shows an active chronic ureteritis, with consequent thickening of both wall and mucosa.

There is no evidence that this was a tuberculous lesion (*Figs.* 789, 790).

The patient made an uneventful recovery; her wounds healed rapidly and she was discharged from hospital one month after the operation.

She was followed up in the Out-patient Department for approximately 9 months, as a small superficial sinus reformed in the loin. This finally healed without further surgical intervention. When last seen two months ago, precisely three years after the operation, she was in excellent health, symptom-free, and with all wounds soundly healed. She is now married and has recently increased her family.

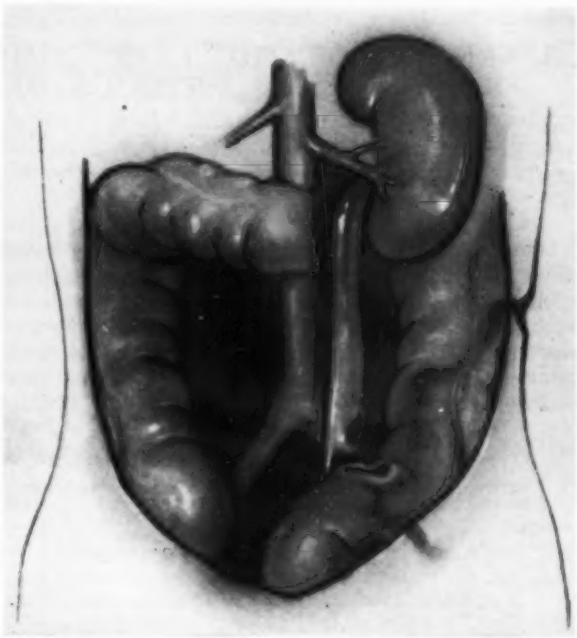


Fig. 791.—Showing the fistula between the left ureter and the pelvic colon.

SUMMARY

The case of a spontaneous left ureterocolonic fistula is reported. This was at the level of the pelvic brim, and due to an untreated impacted stone in the ureter. The kidney above was non-functioning, pyonephrotic, and contained a large calculus.

The drainage of a lumbar abscess revealed a fæcal fistula, believed to be due to a peri-ureteric abscess that had ruptured into the colon.

Following radical surgical treatment, the patient made an uneventful recovery, remaining well three years after the operation.

I wish to express my thanks to Mr. J. Rubin, under whose care this patient was admitted, for his kind permission to treat and publish this case. I am most grateful to Drs. J. Dawson and R. I. Roberts for their radiological assistance, and to Dr. H. G. H. Richards for the histological report on the removed specimen. My thanks are also due to Mr. Cranny for the photography.

REFERENCES

GOW, J. G. (1951), *Brit. J. Surg.*, **39**, 92.
SHUCKSMITH, H. S. (1941), *Ibid.*, **29**, 256.

EXPERIMENTAL SURGERY

PREVENTION OF THE LATE COMPLICATIONS OF URETEROCOLOSTOMY BY METHODS OF FÆCAL EXCLUSION*

By W. T. IRVINE†, C. ALLAN, and D. R. WEBSTER

FROM THE DEPARTMENT OF EXPERIMENTAL SURGERY, MCGILL UNIVERSITY, MONTREAL

INTRODUCTION

Improvements in technique, together with sulphonamides and antibiotics, have made ureterocolostomy a progressively less formidable procedure from the standpoint of immediate post-operative mortality. Now the late complications of renal damage and electrolyte imbalance are being more closely studied. Modern techniques of ureteral implantation have not abolished these complications. Exclusion of the fæcal stream by proximal colostomy or ileal bladder has been introduced and early results appear favourable. However, the follow-up of these exclusion methods is short and ureterocolostomy alone gives favourable initial results. In this paper the incidence of renal damage and electrolyte upset following ureterocolostomy alone will first be reviewed. The results so far obtained clinically by exclusion methods will then be mentioned. An experimental study will then be described contrasting the incidence of these late complications with and without fæcal exclusion.

RENAL DAMAGE FOLLOWING URETEROCOLOSTOMY

It is not easy to assess the degree of renal damage in such cases from a study of the literature. Often no pyelographic studies have been done after the initial post-operative survey and frequently the follow-ups are short. In *Table I* a selection from the published series is presented and information as to length of follow-up, renal damage, etc., is summarized. From *Table I* it will be seen that most authors have recorded definite renal damage in approximately two thirds of such patients. Although other authors also emphasized the importance of renal damage (Henderson, 1953; Smith, 1947), many earlier reports stressed the satisfactory renal status of these patients (Walters, 1934; Heplar, 1940; Lower, 1943).

Table I.—Incidence of Renal Damage after Ureterosigmoidostomy as Reported by Various Authors

Author	Number of Patients Traced	Length of Follow-up	Number Alive		Number of Deaths		
			Total	Number with Renal Damage	Total	Number with Renal Damage	Total with Renal Damage
Grey Turner, 1926–43	12	Over 16 yr.	9	7	3	3	83·3 per cent
Soderlund, 1944	12	6 mth. to 8 yr.	8	—	4	1	8·35 per cent
Hellstrom and Romanis, 1946	41	6 mth. to 5 yr.	28	8	13	5	31·9 per cent
Higgins, 1950	60	6 mth. to 5 yr.	55	0	5	0	0
Cordonnier and Lage, 1951	48	Up to 2½ yr.	48	21	—	—	44·0 per cent
Harvard and Thompson, 1951	128	105 over 5 yr.	68	46 (66·7 per cent)	59	38 (65·0 per cent)	65·6 per cent
Howard, 1949	5	6 mth. to 5 yr.	3	1	2	2	60·0 per cent
Sanderud, 1953	10	6 mth. to 21 yr.	5	2	5	5	70·0 per cent
Garrett and Mertz, 1954	11	6 mth. to 5 yr.	11	6	0	0	54·5 per cent
Strombeck, 1954	61	Over 1 yr.	61	43	—	—	70·5 per cent

One must conclude from the above evidence, based on renal symptoms, urograms, and autopsy reports, that renal damage occurs in a high proportion of patients following ureterocolostomy. If such patients do not die of the original disease, large numbers of them have renal deaths at a later date.

HYPERCHLORÆMIC ACIDOSIS FOLLOWING URETEROCOLIC ANASTOMOSIS

The high incidence of electrolyte imbalance has only recently been recognized. Boyd (1931) noticed chronic acidosis in a boy after ureteral transplantation in 1931, and Jewett (1940) observed a similar state in dogs after transplantation of ureters to the rectum. However, to Ferris and Odel (1950) must go the credit of demonstrating the importance and frequency of this complication. In 1950 they reported the results of blood chemistry studies in 141 such patients who had undergone ureterocolostomy at the Mayo Clinic; 79 per cent had hyperchloræmia and 80 per cent showed a reduced plasma bicarbonate level. The majority of these patients were well despite the altered blood chemistry. However, some had developed a characteristic clinical syndrome consisting of weight loss, excessive thirst, a salty taste in the mouth, and excessive fatigue. Since then this complication has

* Supported by a grant from the National Research Council of Canada.

† Present address: Department of Surgery, University of Glasgow.

been observed by many authors. *Table II* presents in tabulated form the larger recorded series giving the incidence of electrolyte imbalance.

In addition to hyperchloræmic acidosis, a fall in serum potassium levels has been frequently noted. Such reductions in the serum potassium are much less common than hyperchloræmia. However, Wilkinson (1952) has considered hypokalæmia responsible for much of the disability.

Table II.—INCIDENCE OF HYPERCHLORÆMIC ACIDOSIS FOLLOWING URETEROSIGMOIDOSTOMY (Various Authors)

AUTHOR	CASES INVESTIGATED	INCIDENCE	NOTE
		per cent	
Ferris and Odel, 1950	141	80	
Lapides, 1951	22	77	
Cordonnier and Lage, 1951	21	100	At some time
Berglin and Mathisen, 1952	31	100	At some time
Jacobs and Stirling, 1952	201	40·3	
Creevy and Reiser, 1952	81	59·3	
Garrett and Mertz, 1954	12	100	At some time

THE AETIOLOGY OF HYPERCHLORÆMIA ACIDOSIS FOLLOWING URETEROCOLOSTOMY

1. Selective Absorption of the Urinary Constituents by the Colonic Mucosa.—The physiological studies of Goldschmidt and Dayton in 1919 and Visscher, Fletcher, Carr, Gregór, Bushey, and Barker in 1944 demonstrated the ability of the colon mucosa to absorb Cl ions. The work of Baird and Scott (1917), and Bollman and Mann (1927), had long demonstrated that chloride and urea are absorbed from urine across the colonic mucosa. Unlike urea, creatinine was found not to be reabsorbed (Ferris and Odel, 1950; Boyce, 1951).

Ferris and Odel considered selective absorption of chloride and urea by the colon mucosa the main aetiological factor in hyperchloræmic acidosis. The fact that the plasma creatinine levels were normal and urography usually showed good concentration suggested to them that renal function was not impaired. Annis and Alexander (1952) instilled physiological saline, tap water, and urine into two patients with defunctioning colostomies and found chloride was absorbed in large excess of sodium. Similar findings were reported by Parsons, Pyrah, Powel, Reed, and Spiers (1952) using urine enema studies. Rosenberg (1953), in dog experiments, found that venous blood draining the sigmoid wall contained more ammonium chloride and urea than did peripheral blood when urine was in the colonic lumen. Many other authors (Boyce, 1951; Boyce and Vest, 1952; Mitchell and Valk, 1953) produced evidence to support the theory that absorption was the main cause of this electrolyte imbalance.

2. The Renal Factor in the Causation of Hyperchloræmic Acidosis.—Kekwick, Paully, Richards, and Semple in 1951 noticed after transplantation of one ureter to the cæcum and one into the sigmoid, 4 patients who had developed fatal hyperchloræmic acidosis with nitrogen retention. At autopsy, 2 of these cases showed severe renal damage, a third showed patchy renal damage with tubular changes, the fourth only tubular changes. They believed renal damage the all-important factor in production of this syndrome, as did Lapides (1951) and Creevy and Reiser (1952).

Jacobs and Stirling (1952) from a study of 201 patients also considered the renal factor more important than absorption. They argued that if absorption alone was the aetiological mechanism, imbalance might be expected in all cases as soon as continence developed. Since in their series only 40·3 per cent developed imbalance and the incidence increased in the later post-operative period, some other factor was thought to operate. Like many others they found a much higher incidence of the syndrome in those patients with poor renal function.

Some authors who consider the renal factor an important one, have mentioned that tubular damage alone might produce the upset. Especially has this theory been invoked when pyelographic and other evidence revealed no gross renal damage. However, there is very little histological evidence to support this view and when morphological changes have been reported there is no proof that they are necessary for the presence of imbalance.

Renal tubular damage and chronic acidosis have been found together in conditions unrelated to ureterosigmoidostomy. Peterman (1945) reported on a two-month-old child with severe pyelonephritis and chronic acidosis. Autopsy studies demonstrated the tubules filled with granular debris. Calcium appeared to have petrified the epithelial cells. Similar cases with tubular damage and chronic acidosis have been reported by others (Butler, Wilson, and Farber, 1936; Baines, Barclay, and Cook, 1945; Greenspan, 1949). The relationship of renal tubular changes to the presence or absence of hyperchloræmic acidosis, under controlled experimental conditions, will be described later.

The absence of histological changes in the kidneys may not exclude a renal factor entirely. Inhibition of the renal carbonic anhydrase produces hyperchloræmic acidosis (Mann and Keilin, 1940; Maren, 1952; Brazeau and Gilman, 1953). Ascending infection might inhibit the activity of this tubular enzyme before histological changes are evident. From the work of Pitts (1950), and Berliner, Kennedy, and Orloff (1951), it now appears that one of the most important mechanisms by which sodium is reabsorbed from the glomerular filtrate is by exchange with hydrogen and potassium ions secreted into the lumen by the tubular cells. Availability of renal cell hydrogen ion is determined by the activity of carbonic anhydrase. When available hydrogen ion is reduced by inhibition of carbonic anhydrase, sodium excretion increases. Odel, Ferris, and Priestley, in 1951, reported increased sodium excretion from the kidney after ureterocolostomy (urine collected by nephrostomy tube) and the urine of such patients is usually alkaline. It would be interesting to know if the activity of this enzyme is inhibited following ureterocolostomy. The renal carbonic anhydrase activity of dogs with chemical imbalance following deviation of urine to the colon will be reported later.

It must be concluded that renal damage and electrolyte disturbance are frequent complications of ureterocolostomy. There is no substantial clinical evidence that modern implantation techniques have lessened these hazards.

Since modern implantation techniques failed to reduce these complications, interest has been renewed in methods of fæcal exclusion. Rubin (1948) has recently reviewed the methods used previously. At the present time, isolated ileal bladders (Bricker, Butcher, and McAfee, 1954; Annis, Hunter, and Wells, 1954), ileocæcal bladders (Merricks and Gilchrist, 1954), and isolated rectosigmoid bladders (Pyrah, 1954), are all being used.

The clinical evidence that any of these exclusion techniques materially reduce the late hazards of ureterocolostomy is not yet conclusive, since follow-ups are short. Only isolated ileal bladders have been performed in sufficient numbers for study. The absence of chemical imbalance is convincing but the incidence of renal infection (30 per cent) within six months of operation has to be considered. Since a certain number of ureteral transplants appear unsatisfactory by any technique, this factor may account for some of these renal complications. The results of the isolated rectosigmoid bladder and ileocæcal bladder appear very favourable but the numbers reported are few.

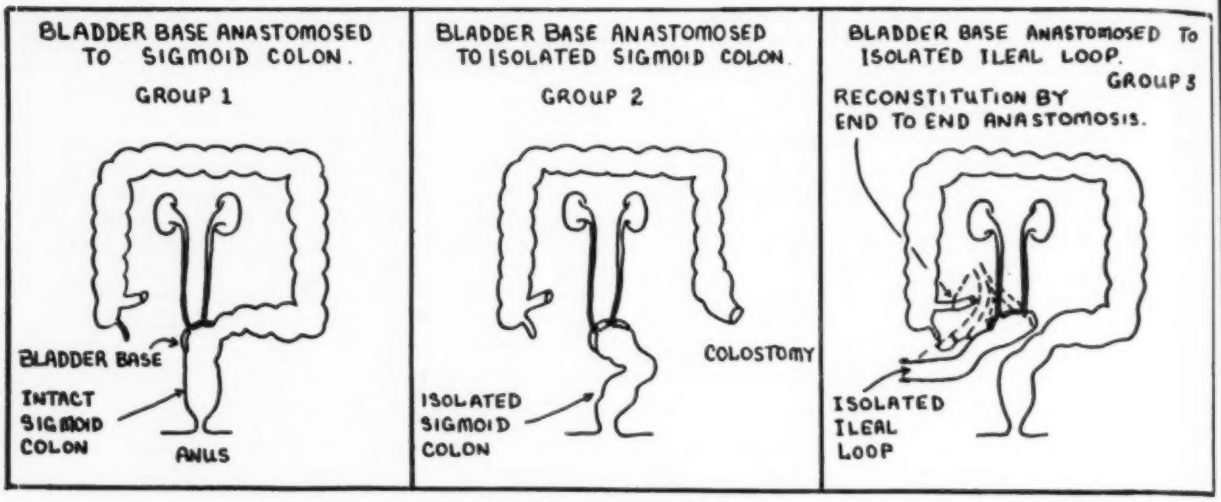


FIG. 792.—Diagrammatic representation of operative procedures.

EXPERIMENTAL ASSESSMENT OF TWO EXCLUSION METHODS

Objectives of the Experiment.—

1. To assess the incidence and severity of renal damage and electrolyte disturbance following deviation of urine to the colon in continuity, to the colon with proximal colostomy and to isolated segments of ileum.

2. It was hoped to exclude the variable factor of ureteral implantation from the experiment by implanting the bladder base with the ureterovesical orifices undisturbed. It is not suggested that this method of implantation is suitable for use in clinical surgery.

3. When hyperchloræmic acidosis developed, a search was made for evidence of a renal factor. (*a*) Kidney damage was assessed by histology and pyelography. (*b*) A special study of the tubules was undertaken, for evidence of morphological change. (*c*) The carbonic anhydrase activity of the renal cortex was measured.

4. The colon and ileal mucosæ were studied for any evidence of metaplasia produced by contact with urine.

Methods.—This report is based on 39 mongrel dogs of both sexes, and weights between 20 and 60 pounds. Only dogs with normal intravenous pyelograms were used in this experiment and all animals were apparently healthy.

Before surgery the following blood chemistry studies were done: Plasma Na and K (internal standard flame photometer), plasma chloride (Hiller's modification of Sendroy's method), blood creatinine (technique of Folin and Wu), blood-urea nitrogen (Van Slyke), and the plasma carbon-dioxide-combining power (Van Slyke's manometric technique).

The dogs were then assigned alternately to one of three groups for surgery. The colon was prepared by enemata and oral neomycin (4 g.) for two days prior to operation. Under intravenous nembutal anæsthesia, the abdomen was opened and the urethra divided between ligatures. The fundus of the bladder was then excised and its base with the undisturbed ureterovesical orifices used for implantation as follows:

Group I (14 dogs). An ellipse was removed from the sigmoid colon and the bladder base anastomosed to the opening in two layers.

Group II (13 dogs). The upper sigmoid colon was divided and the proximal end brought out as a terminal colostomy. The bladder base was anastomosed to the open distal end of the colon.

Group III (12 dogs). A loop of terminal ileum 6 in. to 8 in. long was isolated with intact blood-supply and ileal continuity restored by end-to-end anastomosis. The bladder base was then anastomosed to the proximal end of the ileal loop, the

distal end being brought out to form an ileostomy stoma.

Fig. 792 is a diagrammatic representation of the three operative procedures used.

On recovery from operation, the dogs were maintained on a farm, each group receiving the same mixed diet. Each dog returned at intervals of 2–3 weeks for repetition of the blood chemistry studies.

RESULTS

General Nutrition of Dogs in Post-operative Period.—The dogs in the group with implantation into the colon in continuity lost weight and their condition deteriorated as the experiment progressed. Two dogs in this group required intravenous fluids for severe acidosis. The dogs with ileal or rectosigmoid bladders maintained their weight and general condition throughout the experiment.

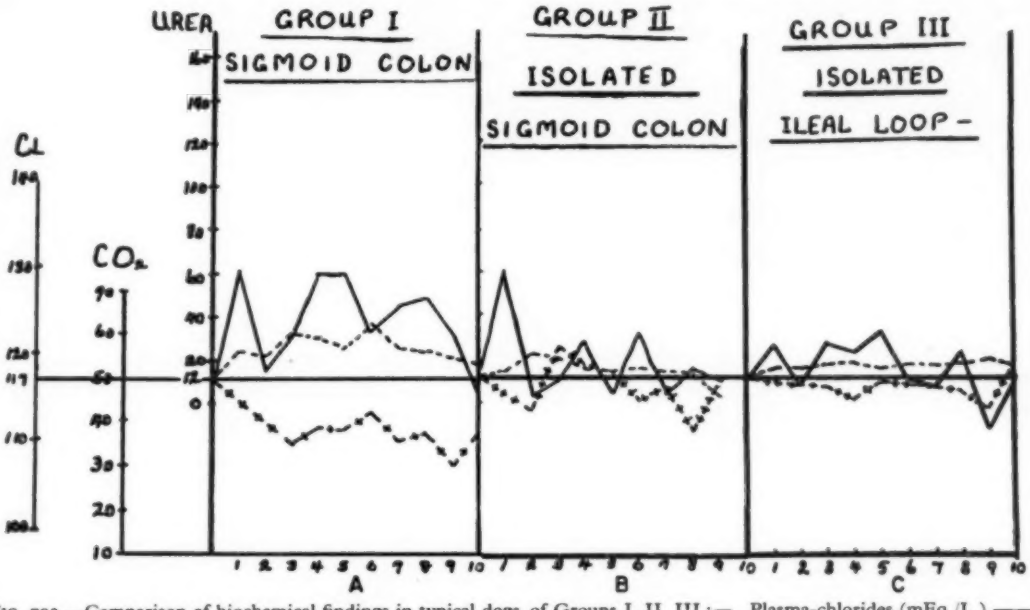


FIG. 793.—Comparison of biochemical findings in typical dogs of Groups I, II, III :— Plasma-chlorides (mEq./L.) ———. Blood-urea nitrogen (mg. per cent) – – –. Plasma CO_2 combining power (vols. per cent) – + – + –.

Approximately nine months after surgery, the animal had its final blood chemistry estimations. A second intravenous pyelogram was then done for comparison with the normal pre-operative films. The presence or absence of ureteral reflux was also determined radiologically, by introducing 12 per cent NaI into the colon or ileum until a pressure of 30 mm. Hg was recorded and then taking a radiograph of the lower abdomen and pelvis. After sacrifice, the urinary tract and that part of the alimentary tract exposed to urine were studied macroscopically and microscopically.

Renal carbonic anhydrase activity was estimated by Davenport and Wilhelmi's technique (1941), using a Warburg manometer with flasks calibrated at 2·2 c.c. volume (temperature 5° C.). Homogenized preparations from the perfused renal cortex were made for estimating the enzyme's activity. A 0·2 mol phosphate buffer (*p*H 6·6) was used, the substrate being 0·025 mol $NaHCO_3$ in 20 per cent glucose. With this manometric technique it was found that the smallest concentration of enzyme solution which gave a reading above the blank was 0·05 c.c. of a 1–100 dilution of the supernatant fluid from the homogenized renal cortex. The concentration curve demonstrated a steep rise levelling off at 0·1 c.c. of a 1–100 dilution. The greatest dilution which gave an appreciable increase over the blank reading without being on the top of the curve was 0·90 c.c. This concentration was therefore used throughout the experiments.

Biochemical Estimations.—From the pre-operative blood chemistry studies the following normal range and mean values were determined:

Plasma chloride: mean 117·0 mEq./L. (S.D. 2), range 113·0–121 mEq./L.

Plasma carbon dioxide combining power: mean 50·2 v.p.c. (S.D. 5·0), range 40–60 v.p.c.

Blood-urea nitrogen: mean 12·0 mg. per cent (S.D. 3·8), range 5·1–20·3 mg. per cent.

Blood creatinine: mean 1·05 mg. per cent, range 0·75–1·35 mg. per cent.

Plasma Na: mean 152·9 mEq./L., range 145–161 mEq./L.

Plasma K: mean 4·05 mEq./L., range 3·0–4·9 mEq./L.

a. Alterations in Blood Chemistry after Urinary Deviation to the Colon in Continuity (Group I).—All 14 dogs developed hyperchloræmic acidosis. This imbalance usually started within 6 weeks of surgery. In all these dogs fluctuations occurred but the chloride and CO_2 combining power returned to normal only for brief periods. The blood-urea nitrogen remained just above the upper limits of normality throughout the post-operative period, while the blood creatinine was not elevated. Na and K estimations remained within normal limits, the K levels not infrequently reaching the lower limits of normality in this group. *Fig.* 793, A is typical of the post-operative course of dogs in this group.

b. Alterations in Blood Chemistry after Urinary Deviation to the Isolated Rectosigmoid (Group II).—In the 13 dogs in this group the blood chloride and CO_2 combining power remained for the most part within normal limits. However occasional periods of temporary imbalance developed. The blood-urea nitrogen remained at the lower limits of normal throughout the experiment. The blood creatinine, plasma Na and K estimations remained normal. *Fig.* 793 B is typical of the electrolyte changes in this group of dogs. Comparing the graphs of individual dogs in Groups I and II it might be true to say that there were only occasional periods of normality in Group I while in Group II there were only occasional periods of abnormality.

c. Alterations in Blood Chemistry after Urinary Deviation to Isolated Ileal Loops (Group III).—The plasma chloride, CO_2 combining power and blood-urea nitrogen remained within normal limits throughout the experiment and all other blood chemistry estimations remained normal. *Fig.* 793 C demonstrates the total absence of fluctuations in the chloride, CO_2 combining power, and blood-urea nitrogen in dogs of this group.

When the mean plasma chloride levels for each of the three groups is followed through the post-operative period, the higher levels in Group I are apparent (*Fig.* 794). Similarly when the means of the CO_2 combining power estimations are plotted for each group, continued acidosis is limited to

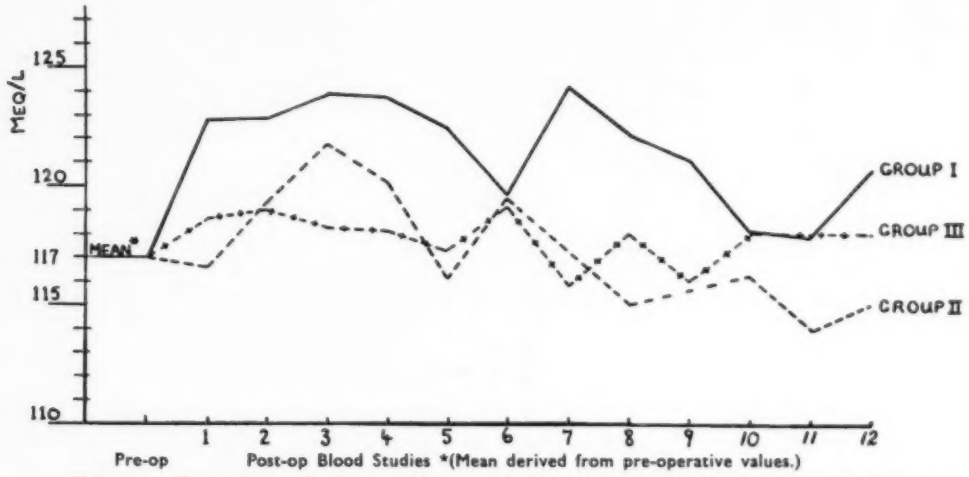


FIG. 794.—Comparison of plasma chloride following three methods of urinary deviation :— To intact colon ———, isolated sigmoid colon – – –, isolated ileal loop –+–+–. Serial determinations over 6–9-months post-operative period.

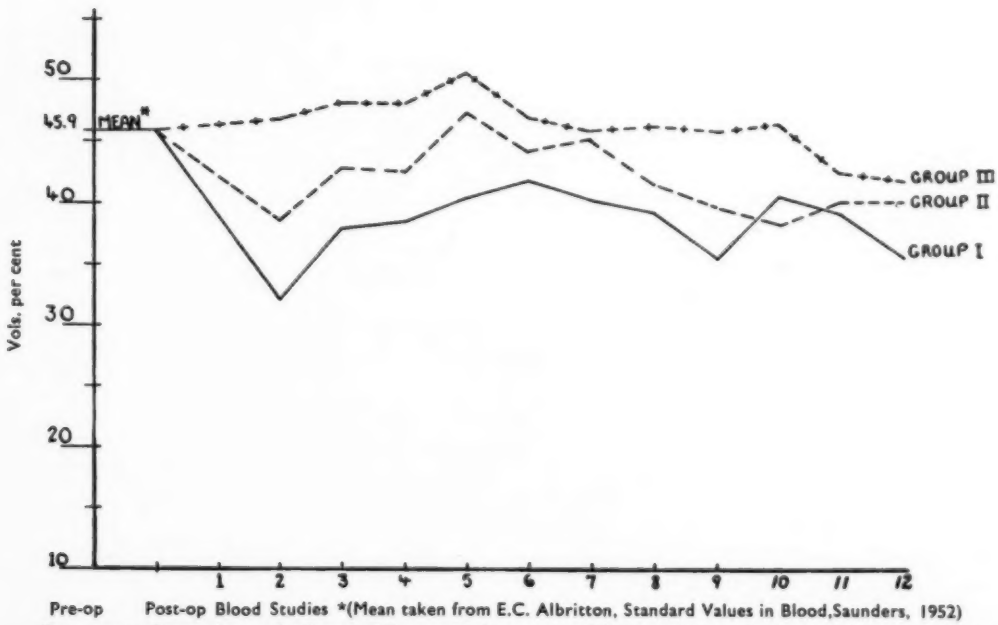


FIG. 795.—Comparison of plasma CO_2 combining power following three methods of urinary deviation :— To intact colon ———, isolated sigmoid colon – – –, isolated ileal loop –+–+–. Serial determinations over 6–9-months post-operative period.

Group I (*Fig.* 795). The mean blood-urea levels (*Fig.* 796) demonstrate the slightly higher levels in Group I as compared with Groups II and III. Since the blood creatinine was not elevated in Group I, the slightly higher urea levels may be explained by the larger area of colon mucosa exposed to urine, in this group.

Autopsy and Histological Studies.—

a. Gross Changes.—The kidneys on section frequently showed some thickening of the renal pelvis in Group I and occasionally in the other groups. The cortex frequently looked completely normal. Sometimes tiny pin-point foci of inflammatory change were seen in the cortex but these were never extensive. No ureters were grossly dilated. The implanted bladder was well healed. The ureter mouths were all probed. None were stenosed, but some appeared patulous.

b. Histological Changes.—Kidneys : Pyelonephritis when present was graded to allow comparisons between the groups. When inflammatory changes were almost limited to slight changes in the pelvis, the grade minimal was used. When moderate, a more marked pelvic reaction was present with extension of foci to the medulla and perhaps an occasional cortical focus. When the pelvic reaction was severe with extension of multiple foci into cortex, pronounced pyelonephritis was present. However, even when pronounced, the multiple cortical foci were still small and the amount of normal cortical tissue not yet extensively reduced. *Table III* gives the incidence and degree of pyelonephritis in the three groups of dogs. *Fig.* 797 is a photomicrograph of a typical dog of Group I showing pronounced pyelitis with extension to the parenchyma. *Fig.* 798 demonstrates how normal the renal pelvis and cortex frequently appeared in Groups II and III.

The classification used in *Table III* does not fully illustrate the differences between the groups. In Groups II and III the inflammatory reaction seen in the renal pelvis sometimes warranted the grading moderate or pronounced pyelitis, yet the number of inflammatory cells in the parenchyma was often limited to 1–2 microscopic foci. A similar degree of pelvic inflammatory change in Group I was usually associated with numerous microscopic foci of inflammatory cells in the cortex.

There was no dog in Group I without pyelitis. The kidneys of three dogs in this group had the most minimal pyelonephritis with only a few inflammatory cells in the adjacent medulla. The majority showed moderate or pronounced pyelitis with extension of numerous small inflammatory foci into the cortex. At the time of sacrifice, these foci were too small and infrequent to reduce materially the amount of functioning cortex available.

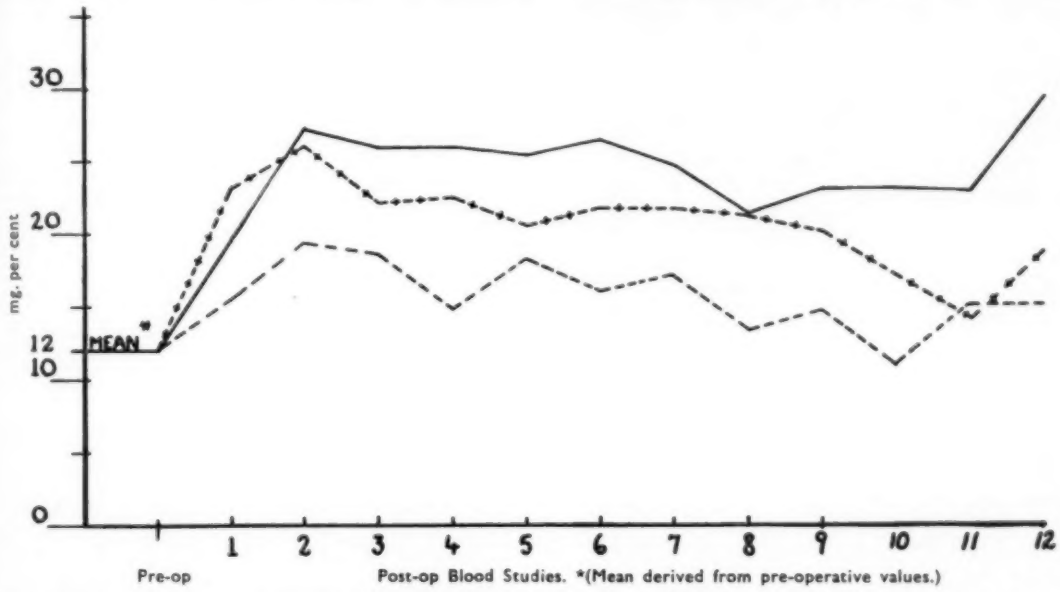


FIG. 796.—Comparison of blood-urea nitrogen following three methods of urinary deviation :— To intact colon ———, isolated sigmoid colon – – – –, isolated ileal loop –+–+–. Serial determinations over 6–9-months post-operative period.

Table III.—INCIDENCE AND DEGREE OF PYELONEPHRITIS IN THE THREE GROUPS OF DOGS

GROUP	NUMBER OF KIDNEYS	NUMBER WITH NO PYELITIS	MINIMAL PYELO-NEPHRI-TIS	MODERATE PYELO-NEPHRI-TIS	PRO-NOUNCED PYELO-NEPHRITIS
I	28	0	7	11	10
II	26	15	5	5	1
III	24	8	8	5	3

In the dogs with colostomies, more than half the kidneys were completely normal. Only one kidney showed pronounced inflammatory changes. Extension to the parenchyma was usually limited to the adjacent medulla and consisted of only a few inflammatory cells. This also applied, in lesser degree, to the kidneys of the ileal bladder dogs. However three kidneys in this group did have pronounced pyelitis with some cortical extension. Two of these kidneys were from a dog where faulty post-operative management had allowed the ileostomy stoma to stenose and a heavy urinary infection followed.

Changes in the Renal Tubules : The tubular changes were studied with the help of Dr. D. Waugh of the Pathological Institute. Although only dogs in Group I developed chemical imbalance, the tubules were essentially similar in all three groups and for

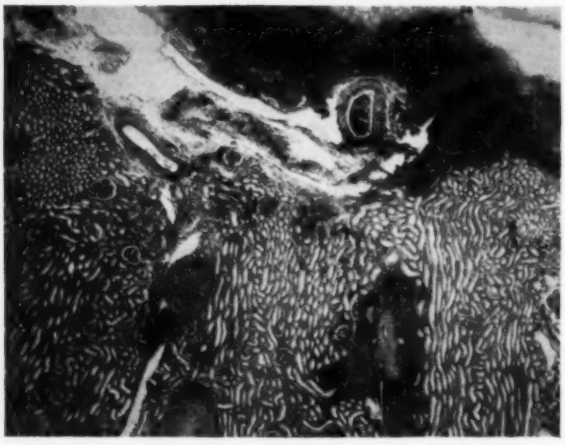


FIG. 797.—Photomicrograph from the kidney of a typical dog in Group I, showing pronounced pyelitis with extension to the cortex. (× 50.)

The results obtained in the different groups are given in *Table IV*.

Radiological Evidence of Sodium Iodide Reflux up Ureters from the Intestine.—The incidence of reflux is given in *Table IV*. Under the conditions of this experiment the ureterovesical valve allowed reflux in 63·6 per cent of dogs in Group I. No reflux occurred in the groups with fæcal exclusion.

Renal Carbonic Anhydrase Activity and Hyperchloræmic Acidosis.—The range of enzyme activity was estimated in normal dogs, in 4 dogs of Group I with chemical imbalance, and in 4 ileal bladder dogs with normal blood chemistries. The activity was expressed in enzyme units following the equation of Meldrum and Roughton (1934), $\frac{R-RO}{RO}$; RO being the reaction rate under identical conditions on the same day without enzyme in the flask ; R being the rate of the enzymatic reaction. In each kidney many estimations were done and only results which were confirmed by duplicate or triplicate estimations were accepted. The enzyme activity of both groups of experimental animals was closely similar and within the normal range. The mean readings for each kidney tested and resultant enzyme activity

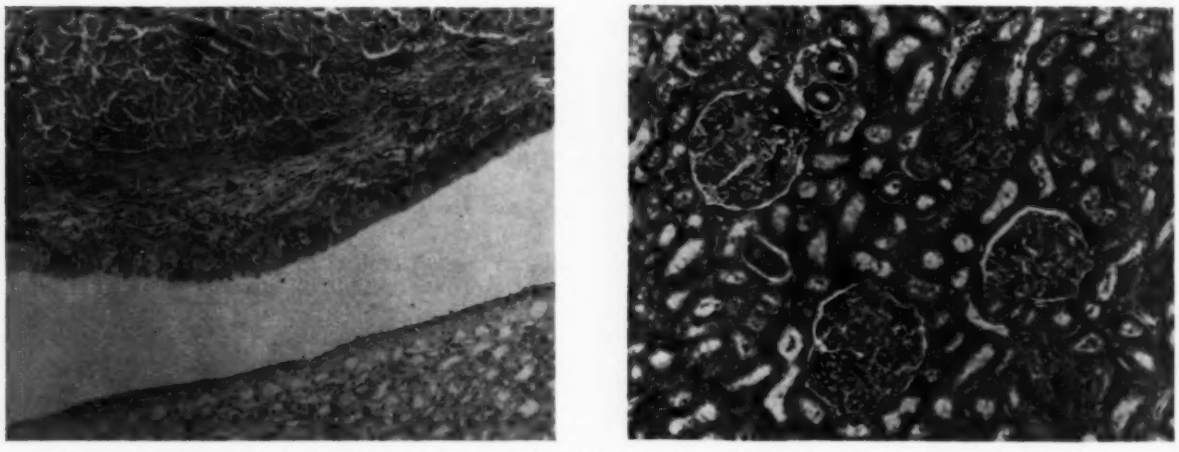


FIG. 798.—Photomicrograph of renal pelvis and cortex of a typical dog in Group II with no evidence of pyelonephritis. (× 200.)

the most part normal except when immediately adjacent to an inflammatory focus. The extensive subnuclear vacuolation or subepithelial calcification seen in some nephrotic syndromes associated with hyperchloræmic acidosis was not observed in these kidneys.

The Ureters : Ureteritis, when present, usually paralleled the changes in the renal pelvis.

Alimentary Mucosa exposed to Urine : After nine months exposure to urine, the colon and ileal mucosæ were essentially normal with no evidence of metaplasia to epithelium of transitional type.

Comparison between Normal Pre-operative Intravenous Pyelogram and Pyelogram before Sacrifice.—The changes seen were usually minor, consisting of slight dilatation of the renal pelvis. When this renal dilatation was accompanied by alteration in the pattern of the calices it was described as moderate. Concentration of the dye was reasonable in all cases. No gross hydronephrosis was seen.

found in both groups is recorded in *Table V*. It will be seen that no reduction in renal carbonic anhydrase was detected in those dogs with chemical imbalance, using the method described.

Comment on Experimental Results.—

1. *Effect of Exclusion Techniques on Renal Damage.*—When the histological findings in *Table III* are analysed statistically, the incidence of normal kidneys is significantly higher in Groups II and III as compared with Group I. The slight difference between Groups II and III is not significant. When pyelonephritis is present, the incidence of pronounced pyelonephritis is significantly less in the dogs with exclusion procedures. Although the I.V. pyelograms showed only minor changes after nine months, these are almost limited to Group I. There was no stenosis of the lower ureters to account for these changes. The ureteral reflux studies demonstrate the effect of the fæcal stream on the normal ureterovesical valve. It suggests that attempts to produce

good valvular mechanism in ureteral transplantation may be defeated, in some cases, when the fæcal stream is not excluded. From the histological and radiological evidence in this experiment it would appear that exclusion techniques provide some degree of protection to the kidney. Thus there are significant differences between the groups only nine months after surgery. Longer survival periods might be expected to accentuate those differences.

Table IV.—Pyelographic Changes and Incidence of Ureteral Reflux in the Three Groups of Dogs

Group	Number of Dogs with Satisfactory Studies	No Pyelographic Changes	Minimal Changes		Moderate Changes		Percentage with Pyelographic Changes	Percentage with Ureteral Reflux
			Unilat.	Bilat.	Unilat.	Bilat.		
I	11	3	3	2	2	1	72·7	63·6
II	10	9	1	0	0	0	10	0
III	11	11	0	0	0	0	0	0

2. *Effect of Exclusion Techniques on Incidence of Hyperchloræmic Acidosis.*—The biochemical results demonstrate the superiority of these exclusion methods over implantation into the intact colon which always produced chemical imbalance. The ileal bladder dogs gave completely normal blood chemistry results throughout the experiment. The dogs with isolated rectosigmoid bladders gave only occasional imbalance. However, in this group, the colon was divided much more proximally than would be done in a human case, since the dog retains urine for long periods and a capacious bladder was considered desirable. A smaller rectosigmoid bladder with frequent voiding would reduce the absorptive surface and probably give results as good as those obtained with ileal bladders.

3. *Aetiology of Hyperchloræmic Acidosis.*—The biochemical data in this experiment lend support to the belief that absorption of ions across the colon mucosa is the most important factor. The onset of imbalance soon after surgery, and the reduction in severity of the chemical upset achieved by reducing the area of colon exposed to urine, both favour absorption as the cause. No evidence could be found that renal damage was a primary factor. Although the kidneys in Group I had usually more pronounced pyelonephritis, at the time of sacrifice, there was still no substantial reduction in the area of histologically normal cortex. Hyperchloræmic acidosis was no less marked in the three dogs in Group I with minimal pyelitis and almost no extension of inflammation to the medulla. A careful study of the renal tubules of these dogs revealed no evidence of selective tubular damage to account for the chemical imbalance. Nor was any reduction in the renal carbonic anhydrase activity detected by the manometric method used. However, when extensive renal damage develops, it may become an important secondary factor, increasing the severity of the acidosis.

Table V.—Results of Determinations of Carbonic Anhydrase Activity in Renal Cortex of Dogs with and without Hyperchloræmic Acidosis

Experimental Group	Dog Number	UL of CO_2 at 3 min. (5°)	Blank	Enzyme Units	Conversion Factor from Perfused to Wet Weight	Enzyme Units per mg. Renal Cortex Wet Weight
Group I Implantation into the colon in continuity with chemical imbalance	1 R.	133	102	·30	1·27	·38
	1 L.	133	102	·31	1·42	·43
	2 R.	130	102	·27	1·53	·41
	2 L.	141	101	·40	1·37	·55
	3 R.	135	97	·39	1·33	·52
	3 L.	143	101	·40	1·55	·62
	4 R.	141	104	·35	1·41	·50
	4 L.	129	102	·26	1·41	·37
Group III Implantation into ileal bladders. No acidosis.	1 R.	131	101	·30	1·68	·50
	1 L.	133	100	·33	1·39	·47
	2 R.	140	104	·34	1·33	·46
	2 L.	122	94	·30	1·28	·38
	3 R.	129	100	·29	1·56	·47
	3 L.	148	111	·33	1·43	·47
	4 R.	124	90	·37	1·36	·51
	4 L.	152	104	·47	1·32	·61

SUMMARY AND CONCLUSIONS

1. The incidence of renal damage and electrolyte imbalance following ureterocolostomy, has been reviewed. About two-thirds of such patients show evidence of renal damage. The reported incidence of hyperchloræmic acidosis varied between 50–100 per cent.

2. The present methods used to exclude the fæcal stream from the site of ureteral implantation

have been described, and their present status discussed. Patients with isolated rectosigmoid or ileal bladders rarely develop chemical imbalance and renal damage appears less, though such cases have not been observed for long periods.

3. Both these exclusion methods gave a significantly lower incidence of renal damage, when studied under carefully controlled experimental conditions. Ileal bladder dogs showed no chemical imbalance while those with rectosigmoid bladders developed only transient imbalance. In this experimental study no evidence could be found to support the view that renal damage is necessary before hyperchloræmic acidosis develops.

4. It was noted experimentally that the normal ureterovesical valve mechanism became incompetent in 63·6 per cent of dogs within 9 months, when exposed to the fæcal stream. This suggests that better implantation techniques alone are unlikely to solve the problems of these late complications.

5. It is concluded that some form of fæcal exclusion should be practised, to protect the kidneys, when ureteral transplantation is done under conditions where long term survival appears likely.

6. In patients with a short life expectancy, ureterocolostomy alone still appears a reasonable procedure. The clinical and experimental evidence suggests that nearly all these patients will develop hyperchloræmic acidosis but the severity of this condition can be lessened by frequent bowel movements and the administration of alkalis by mouth. Since absorption of the urinary constituents would appear to be the most important factor in the development of electrolyte imbalance, it would appear profitable to examine ways of reducing the absorptive power of the colon mucosa. This latter possibility is now being studied experimentally.

BIBLIOGRAPHY

ANNIS, D., and ALEXANDER, M. K. (1952), *Lancet*, **2**, 603.
— — HUNTER, W. R., and WELLS, C. (1954), *Brit. J. Surg.*, **42**, 290.
BAINES, G. H., BARCLAY, J. A., and COOK, W. T. (1945), *Quart. J. Med.*, **14**, 113.
BAIRD, J. S., and SCOTT, R. L. (1917), *Surg. Gynec. Obstet.*, **24**, 482.
BERGLIN, T., and MATHISEN, W. (1952), *Acta chir. scand.*, **104**, 130.
BERLINER, R. W., KENNEDY, T. J., and ORLOFF, J. (1951), *Amer. J. Med.*, **11**, 274.
BOLLMAN, J. L., and MANN, F. C. (1927), *Proc. Soc. exp. Biol., N.Y.*, **24**, 923.
BOYCE, W. H. (1951), *J. Urol.*, **65**, 241.
— — and VEST, S. A. (1952), *Ibid.*, **67**, 169.
BOYD, J. D. (1931), *Amer. J. Dis. Child.*, **42**, 366.
BRAZEAU, P., and GILMAN, A. (1953), *Amer. J. Physiol.*, **175**, 33.
BRICKER, E. M., BUTCHER, H., and MCAFEE, C. A. (1954), *Surg. Gynec. Obstet.*, **95**, 469.
BUCHANAN, J. (1908), *Ibid.*, **8**, 146.
BUTLER, A. M., WILSON, J. L., and FARBER, S. (1936), *J. Pediat.*, **8**, 489.
CORDONNIER, J. J., and LAGE, W. J. (1951), *J. Urol.*, **66**, 565.
CREEVY, C. D., and REISER, M. P. (1952), *Surg. Gynec. Obstet.*, **95**, 589.
DAVENPORT, H. W., and WILHELMI, A. (1941), *Proc. Soc. exp. Biol., N.Y.*, **48**, 53.
FERRIS, D., and ODEL, H. (1950), *J. Amer. med. Ass.*, **142**, 634.
GARRETT, R. A., and MERTZ, J. H. O. (1954), *J. Urol.*, **71**, 299.
GOLDSCHMIDT, S., and DAYTON, A. B. (1919), *Amer. J. Physiol.*, **48**, 419.
GREENSPAN, E. M. (1949), *Arch. intern. Med.*, **83**, 271.
HARVARD, B. M., and THOMPSON, G. F. (1951), *J. Urol.*, **65**, 223.
HELLSTROM, J., and ROMANIS, R. (1946), *Acta chir. scand.*, **93**, 439.
HENDERSON, D. L. (1953), *Brit. J. Urol.*, **25**, 3.
HEPLAR, A. B. (1940), *J. Urol.*, **44**, 794.
HIGGINS, C. C. (1950), *Ibid.*, **63**, 852.
HOWARD, H. H. (1949), *Ibid.*, **61**, 735.
JACOBS, A., and STIRLING, W. (1952), *Brit. J. Urol.*, **24**, 259.
JEWETT, H. J. (1940), *J. Urol.*, **44**, 223.
KEKWICK, H., PAULLY, J. W., RICHES, E. W., and SEMPLE, R. (1951), *Brit. J. Urol.*, **23**, 112.
LAPIDES, J. (1951), *Surg. Gynec. Obstet.*, **93**, 691.
LATNER, A. L., and BURNARD, E. D. (1950), *Quart. J. Med.*, **19**, 285.
LOWER, W. E. (1943), *Trans. Amer. Ass. gen.-urin. Surg.*, **36**, 279.
MANN, T., and KEILIN, D. (1940), *Nature, Lond.*, **146**, 164.
MAREN, T. H. (1952), *Trans. N.Y. Acad. Sci.*, **15**, 53.
MATERN, D. I. (1954), *New Engl. J. Med.*, **250**, 941.
MELDRUM, N. W., and ROUGHTON, F. J. W. (1934), *J. Physiol.*, **80**, 113.
MERRICKS, J. W., and GILCHRIST, R. K., (1954), *J. Urol.*, **71**, 591.
— — — — HAMLIN, H., and RIEGER, T. I. (1950), *Surg. Gynec. Obstet.*, **90**, 752.
MITCHELL, A. D., and VALK, W. L. (1953), *J. Urol.*, **69**, 82.
ODEL, H. M., FERRIS, D. O., and PRIESTLEY, J. T. (1951), *Ibid.*, **65**, 1013.
PACK, M. E., and NEWLAND, D. E. (1952), *J. Amer. med. Ass.* **150**, 177.
PARSONS, F., PYRAH, L. N., POWEL, F., REED, G., and SPIERS, F. W. (1952), *Brit. J. Urol.*, **24**, 317.
PETERMAN, M. G. (1945), *Amer. J. Physiol.*, **144**, 239.
PITTS, R. F. (1950), *Amer. J. Med.*, **9**, 356.
PYRAH, L. N. (1954), *Ann. R. Coll. Surg., Engl.*, **14**, 169.
REMEDI, V. (1906), *Clinica Chir.*, **14**, 608.
RIEGER, I. T. (1953), *Surg. Gynec. Obstet.*, **97**, 317.
ROSENBERG, M. L. (1953), *J. Urol.*, **70**, 569.
RUBIN, S. W. (1948), *Ibid.*, **60**, 874.
SANDERUD, A. (1953), *Acta chir. scand.*, **106**, 117.
SCHEELE, K. (1923), *Z. Urol.*, **17**, 65.
SCHMIEDEN, V. (1923), *Ibid.*, **17**, 1.
SMITH, G. G. (1947), *Surg. Gynec. Obstet.*, **85**, 122.
SODERLUND, G. (1944), *Acta chir. scand.*, **91**, 315.
STROMBECK, J. O. (1954), *Ibid.*, **107**, 178.
TADDEI, D. (1913), *Rev. Chir.*, **47**, 37.
THOMPSON, H. T. (1950), *J. Urol.*, **64**, 85.
TIZZONI and FOGGI (1888), *Zbl. Chir.*, **15**, 921.
TURNER, G. GREY (1943), *Brit. med. J.*, **2**, 535.
VERHOOGEN, J. (1908), *Assn. franç. Urol.*, **12**, 352.
VISSCHER, M. B., FLETCHER, E. S. jun., CARR, C. W., GREGOR, H. P., BUSHEY, M. G., and BARKER, D. E. (1944), *Amer. J. Physiol.*, **142**, 550.
WALTERS, W. (1934), *Amer. J. Surg.*, **24**, 776.
WILKINSON, A. W. (1952), *Brit. J. Urol.*, **24**, 46.
WILSON, A. O. (1953), *Lancet*, **2**, 1178.

SHORT NOTES OF RARE OR OBSCURE CASES

GAS GANGRENE OF THE COLON IN A NEWBORN INFANT

REPORT OF A CASE SUCCESSFULLY TREATED BY TOTAL COLECTOMY

By E. HAIGH

ALDER HEY CHILDREN'S HOSPITAL, LIVERPOOL

Gas gangrene of the colon has been reported as a complication of diverticulitis (Dawson and Hardy, 1948) and of carcinomatous ulceration (Wyman, 1949). Classically it occurs as a result of trauma and gunshot wounds. From 1944 onwards sporadic cases of Darmbrand or necrotizing enteritis (Hansen and others, 1949; Fick and Wolken, 1949) were encountered in Northern Germany. The aetiology was obscure until Zeissler and Rassfeld-Sternberg (1949) isolated a previously unrecognized pathogenic anaerobe with powerful exotoxin, *Clostridium Welchii* type F. The symptoms of Darmbrand varied from those of acute gastro-enteritis to those of paralytic ileus or intestinal obstruction. The jejunum was most frequently affected, but laparotomy or post-mortem examination revealed areas of involvement from the œsophagus to the rectum. Typically the affected bowel was grossly thickened by œdema with necrosis of the mucosa and often the submucosa also.

The anaerobic bacilli are known to be a common inhabitant of the colon in healthy individuals, particularly those feeding from large communal kitchens, and Clostridia can also be cultured from many inflamed appendices (Jennings, 1931).

No previous record has been found of a gas gangrene necrosis of the bowel occurring in a suckling. The case presented here is that of a neonate whose initial bowel flora was apparently almost entirely gas-forming anaerobic Clostridia. This infection produced an enterocolitis which rapidly caused obstruction and bowel necrosis.

CASE REPORT

Baby G. G. was admitted from a Maternity Unit when 90 hours old. He had a normal full-term delivery and his birth weight was 6 lb. 4 oz. Breast-feeding was started after 24 hours and normal meconium and then transitional stools were passed. When 72 hours old he refused feeds and vomited bile-stained material. Twelve hours later copious and numerous stools of mucus and blood were passed. The abdomen became distended and the bowel-sounds were exaggerated and high pitched; the child was pale and toxic and rapidly becoming dehydrated. A straight radiograph of the abdomen showed distended loops of small bowel with numerous fluid levels and some diffuse gas stippling, the significance of which was not appreciated at the time.

A provisional diagnosis was made of low ileal obstruction due to intussusception or volvulus. Gastric suction and intravenous therapy were instituted.

At Operation.—Laparotomy was performed through a transverse supra-umbilical incision. The peritoneal cavity contained a large quantity of straw-coloured fluid of high protein content which set into a stiff jelly on cooling. On initial palpation the transverse colon felt grossly thickened and œdematous, suggesting an intussusception, but on further examination none was found. There was a small Meckel's diverticulum, and from just distal to this down to the pelvic colon the bowel was the purplish colour of impending gangrene. The affected bowel was greatly thickened, œdematous, and crepitant, and numerous subserous gas bubbles were visible. The latter were starting to spread out along the line of the vessels into the mesentery. The coils of small bowel above were dilated as in an obstruction. No vascular lesion was found.

Fig. 799.—Baby G. G. at 13 months, showing good general nutrition and development.

A diagnosis of gas gangrene infection was made. Resection was carried out through normal bowel just above the Meckel's diverticulum to the rectosigmoid region. The rectosigmoid stump distally was closed, being too short to exteriorize suprapubically. The upper end was brought out in the right iliac fossa through

a stab wound as an ileostomy; a rubber catheter was tied into the lumen. Massive doses of penicillin and gas-gangrene serum and a blood transfusion of 85 c.c. were given. Gastric suction and intravenous therapy were continued post-operatively.

PROGRESS.—For the first two days the infant's condition was precarious but by the third day the toxæmia had abated and the ileostomy acted. The catheter was removed from the ileostomy to prevent it ulcerating through

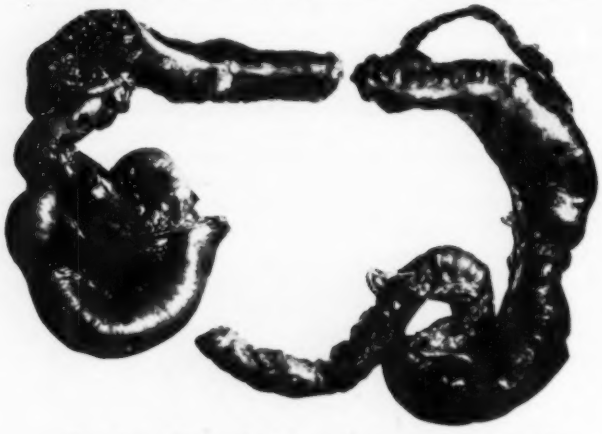


FIG. 800.—The excised lower ileum and colon, showing rupture of cæcum from continued fermentation of the anaerobes in its lumen.

the bowel wall and the neighbouring skin protected with Baltimore paste. Rectal swabs taken daily grew anaerobes up to the second day, but not thereafter. As the general condition was satisfactory on the fifth day, the abdomen was re-opened through a transverse subumbilical incision and an end-to-side anastomosis performed between the ileum and rectosigmoid.

The post-operative course was entirely satisfactory. At first the infant had seven to eight semi-formed stools a day, but developed normally and gained 6 oz. a week. He was discharged after one month. Very little trouble from sore buttocks was encountered, with no evidence of colic or other untoward symptoms. By three months he had only three to five normally-formed stools daily and was gaining well. At one year he now weighs 23 lb. and has only one to two stools a day (*Fig.* 799).

HISTOLOGY.—The specimen consists of 20 cm. of ileum, 5 cm. from the proximal end of which there is a Meckel's diverticulum, the appendix, cæcum, and 35 cm. of colon (*Fig.* 800). The ileum is dilated and the ascending and transverse colon grossly distended and purplish-red in colour, and numerous gas bubbles can be seen beneath the serosa and in the attached mesentery. The cæcum ruptured within a few hours of its removal from continued gas formation in the lumen. No anatomical obstruction of the lumen or vascular abnormality was found.

Sections of the terminal ileum show early ulceration of the tips of the villi and rather more inflammatory reaction in the submucosa. There is increasing inflammatory reaction as the colon is approached with more and larger submucosal and subserous gas spaces. These spaces contain clumps of Gram-positive cocci and large Gram-positive bacilli, some of which are beaded and some bear spores (*Fig.* 801). The mid-colon shows almost complete mucosal necrosis, with advanced peritonitis and the invasion of the necrotic tissues by numerous organisms.

The picture is that of an acute necrotizing enterocolitis associated with advanced cystic pneumatosis.

Bacteriology.—Cultures from swabs of the peritoneal fluid and intestinal and rectal contents grew a predominance of a Gram-positive anaerobic Clostridium. This organism resembled *Cl. capitovale* which has been isolated previously from the fæces in association with infection in both humans and animals. The same organism was cultured also from the nipple skin of the infant's mother.

DISCUSSION

At laparotomy the extensive subserous gas collections and the crepitant feel of the bowel posed the differential diagnosis between massive gas gangrene infection and pneumatosis or gas cysts of the intestine.

Pneumatosis was first described by Bang (1876) and since then about 200 cases have been reported. The majority have been associated with gastric or duodenal ulceration (Hindmarsh, 1953). The mechanism was considered to be that of gas entering a breach in the mucosa and being transported along the bowel by peristalsis (Somerville, 1951). A similar effect has been noted in volvulus (Jones, 1948) and intestinal obstruction (Gasins, Brooke, Lerner, and Price, 1949). Illingworth and Dick (1947) consider pneumatosis to be of no clinical importance, and while this generalization seems to be true of adults, the 12 reported cases of pneumatosis in children have all proved fatal (Stiennon, 1951). These were associated with acute obstruction as the gas collects almost entirely in the submucosal layer obliterating the bowel lumen. Subserous gas cysts are also found post mortem in acute enteritis when mucosal destruction has occurred.

Thus it is impossible to be certain in the case described here whether the gas bubbles were a pneumatosis associated with a necrotizing enteritis

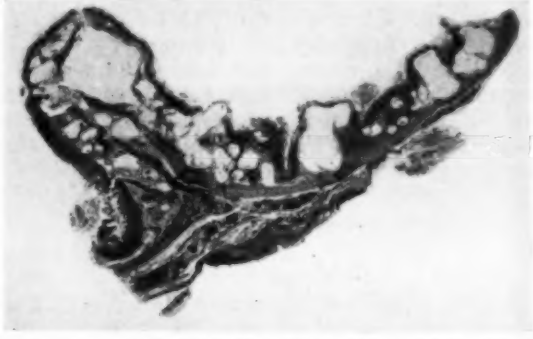


FIG. 801.—Section of the ileocæcal junction showing mucosal destruction and gas spaces.

or actually produced by the Clostridia. But in favour of the latter are the invasion of the wall by the organisms, the frothy contents of the gut, and the continued fermentation in the lumen after excision.

The fact that the Clostridium was not identified as one of the well-recognized human pathogens in adults, does not necessarily detract from its effect as an initial gut flora in a newborn infant. The serious or fatal effects, for instance, of the specific Coli to sucklings, though innocuous to adults, are well known.

Only one previous survival in a neonate, after a gut resection of such magnitude, has been recorded (Wilson, Nelson, and Harshburger, 1954). This was for extensive gangrene due to volvulus with atresia of the right colon. It is noteworthy that in

this infant also no evidence of malnutrition or bowel hurry resulted and the infant thrived very satisfactorily. Young infants with an ileostomy rarely thrive, which suggests that the damming back action of the anal sphincter may be a major factor in a rapid 'colonization' of the bowel immediately above.

The satisfactory post-operative course of this infant suggests that total colectomy with ileoproctostomy may answer the therapeutic problem now provided by long-segment Hirschsprung's disease.

SUMMARY

1. A case is presented of a neonate with gas gangrene involving the lower ileum and the whole of the colon, treated successfully by resection and ileoproctostomy.

2. It is suggested that the infection developed by direct invasion through the mucosa from an acute anaerobic enteritis.

3. The extensive resection was not followed by permanent diarrhœa, malnutrition, or retardation of general development.

4. Total colectomy in the newborn may be a practicable procedure for other conditions.

I should like to thank Miss Isobel Forshall for permission to publish this case and also for her encouragement to take sufficiently drastic action. I also wish to thank Dr. Edward Hall for the bacteriology and Dr. Barbara Ockenden for the histology.

BIBLIOGRAPHY

BANG, B. L. F. (1876), *Nord. med. Ark.*, **8**, 18.
DAWSON, R. L. G., and HARDY, R. H. (1948), *Brit. med. J.*, **1**, 498.
ECKHOFF, N. L. (1930), *Brit. J. Surg.*, **18**, 38.
FICK, K. A., and WOLKEN, A. P. (1949), *Lancet*, **1**, 519.
GASINS, H. I., BROOKE, W. S., LERNER, H. H., and PRICE, P. B. (1949), *Amer. J. Surg.*, **77**, 563.
GORDON, S. (1936), *Brit. J. Surg.*, **24**, 399.
HANSEN, K., and others (1949), *Darmbrand.* Stuttgart: Thieme.
HINDMARSH, F. D. (1953), *Brit. J. Surg.*, **41**, 70.
ILLINGWORTH, C. F. W., and DICK, B. M. (1947), *Text Book of Surgical Pathology*, 5th ed., 499. London: Churchill.
JENNINGS, J. E. (1931), *Ann. Surg.*, **93**, 828.
JONES, J. D. T. (1948), *Brit. J. Surg.*, **36**, 49.
SOMERVILLE, P. (1951), *Lancet*, **2**, 1160.
STIENNON, A. O. (1951), *Amer. J. Dis. Child.*, **81**, 651.
WILSON, B. J., NELSON, A., and HARSHBURGER, M. (1954), *Surg. Gynec. Obstet.*, **99**, 34.
WYMAN, A. L. (1949), *Brit. med. J.*, **1**, 498.
ZEISSLER, J., and RASSFELD-STERNBERG, L. (1949), *Ibid.*, **1**, 267.

A CARCINOMA OF THE THIRD PART OF THE DUODENUM

BY FRANK FORTY, LONDON

CARCINOMA of the duodenum is generally acknowledged to be a rarity. It comprises about 0·3 per cent of carcinomas of the alimentary tract. Some 15 per cent occur in the infrapapillary portion, as compared with 20 per cent in the first part of the duodenum and 65 per cent in the ampullary portion.

It is unusual for infrapapillary carcinomas to be diagnosed pre-operatively and for the condition to be recognized at a treatable stage.

Macindoe (1940) and Beattie and Muir (1949) each reported one case of infrapapillary carcinoma causing vomiting from duodenal obstruction. In both instances a palliative gastrojejunostomy was performed, and both patients died within a week of operation.

Another fatal case was reported by Barclay (1946). This patient had obstructive jaundice as well as persistent vomiting. Pancreatoduodenectomy was performed. The tumour in the infrapapillary region had encroached on the ampulla by upward extension.

In recent years, however, Rogers, Goligher, and Williams (1952) have reported two successful resections, one completed by end-to-end anastomosis and the other by side-to-side anastomosis. Both these tumours had caused obstruction and copious vomiting was the presenting symptom.

Lunn (1952) reported another successful resection completed by end-to-end anastomosis. This patient had been subject to recurrent attacks of vomiting associated with colicky pain.

Dunhill (1952) reported one case in which the growth was found at laparotomy in 1926 in a patient who had had a long dyspeptic history with occasional vomiting. He lived for 21 months after resection and end-to-end anastomosis.

In the case reported below, the diagnosis was suggested by the radiological appearances in the absence of duodenal obstruction and vomiting.

CASE REPORT

H. C. W., a locomotive driver, aged 52, was admitted to Edgware General Hospital on July 12, 1955.

He gave a history of intermittent epigastric pain for the past six months. This was apt to start about an hour after a meal, though sometimes before eating. It did not wake him at night. He had not vomited, but had lost a little weight. There was no history of jaundice.

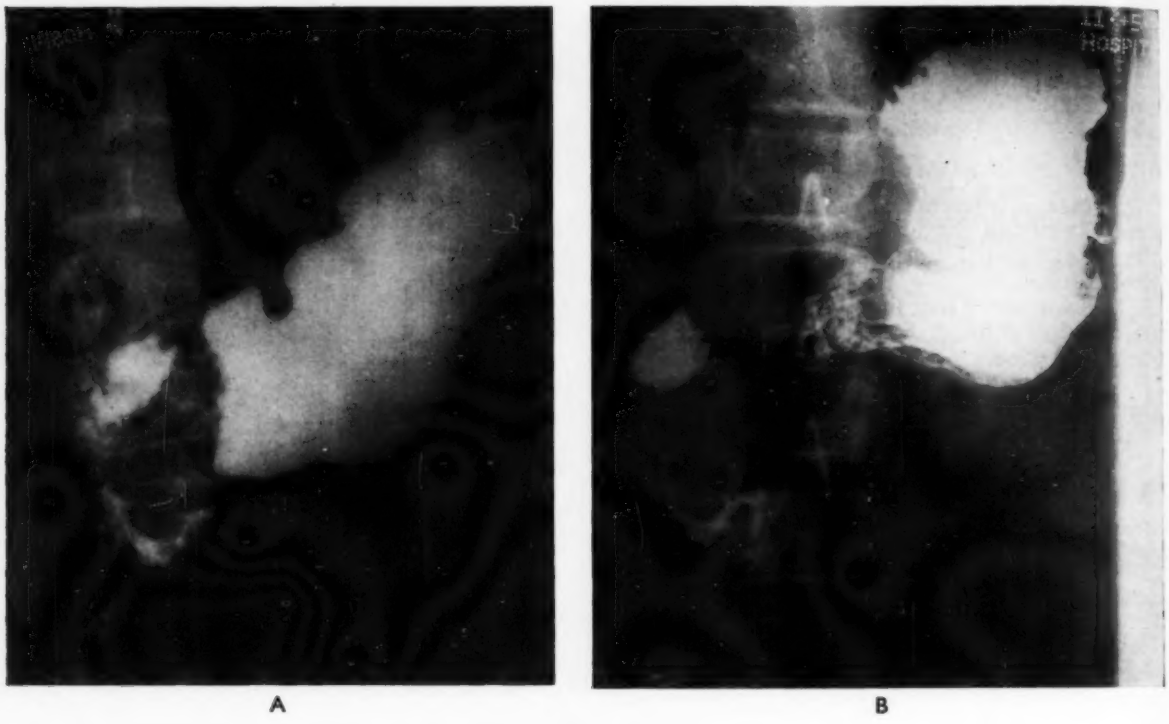
Physical examination revealed no abnormality.

X-ray examination after a barium meal was carried out by Dr. R. W. McNabb, who noted some irritability of the second and third parts of the duodenum. In the lower end of the second part there was an abrupt transition from normal mucosal pattern to an apparently rigid area. These appearances were confirmed at a second examination twelve days later (*Fig.* 802), and were thought to indicate a neoplasm.

AT OPERATION (July 14).—Under general anæsthesia (Dr. D. Reckless) the abdomen was opened through a right upper paramedian incision. A hard mass was felt in that part of the duodenum which lay between the root of the mesentery and the superior mesenteric vessels anteriorly and the inferior vena cava posteriorly. A finger invaginating the anterior wall of the duodenum sank into an ulcer crater which accommodated its tip. This area was firmly adherent posteriorly and its mobilization needed delicate dissection. It was then found

that the ulcer had completely penetrated the wall of the duodenum. There were some enlarged glands locally, but no evidence of remote metastases. The duodenum proximally and the jejunum distally were liberated with the idea of performing a resection and end-to-end anastomosis. Adequate freeing of the duodenum, however, resulted in transection of the lower end of the common bile-duct the open mouth of which was seen on the surface of the exposed head of the pancreas. It was not dilated. It was then evident that a more extensive resection would be necessary. The distal half of the stomach, the duodenum, and the first few inches of the jejunum were therefore removed (*Fig.* 803).

Continuity was restored by thrusting the liberated head of the pancreas with the contained terminal common bile-duct into the open cut end of the jejunum, where it was secured by a row of interrupted silk sutures around which omentum was wrapped. An end-to-side anastomosis was made between the stomach and the jejunum at a lower level. A drain was placed down to the pancreaticojejunal anastomosis and brought out through a stab wound in the right flank, and the abdomen was closed (*Fig.* 804).



A B C

FIG. 802.—A, B, C, three successive radiographs showing abrupt transition at the junction of the second and third parts of the duodenum from the normal mucosal pattern to an apparently rigid area. There is no proximal dilatation of the duodenum.

The patient made a smooth recovery. A small quantity of bile discharged from the drain on the second post-operative day and continued for a few days. The drainage incision was completely healed when the patient left hospital five weeks after operation.

Microscopically the ulcer was necrotic on the surface. In the deeper layers there was an irregular mass of trabecular spheroidal-cell carcinoma (*Fig.* 805).

DISCUSSION

The majority of carcinomas of the duodenum arise from the ampullary region where they grow in a papillary form and soon obstruct the common bile-duct, and the case presents itself as one of obstructive jaundice. Occasionally they are discovered before the onset of jaundice (Forty, 1949).

In the supra-ampullary portion of the duodenum carcinoma is heralded by the same symptoms as a simple peptic ulcer.

In contrast carcinomas of the duodenum arising below the ampulla are relatively silent, causing only vague abdominal discomfort until duodenal obstruction eventually occurs. The early diagnosis of carcinoma in the lower part of the duodenum therefore rests almost entirely on the radiological discovery

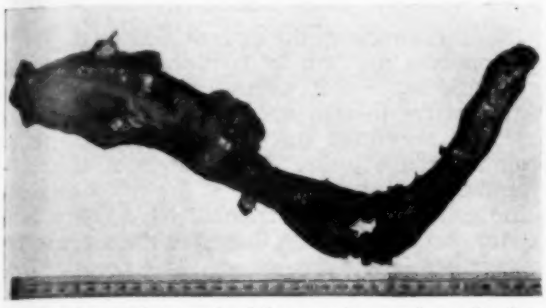


FIG. 803.—Photograph of the operation specimen showing the resected distal half of the stomach and the duodenum. The carcinomatous ulcer has penetrated the posterior wall of the duodenum.

of a deformation of the lumen or of the mucosal pattern and of impaired motility.

Radiologically and at laparotomy the differential diagnosis between carcinoma and simple peptic ulcer of the third part of the duodenum may, however, be impossible. Thus in a case previously reported (Forty and Barrett, 1952) a pancreatico-duodenectomy was performed under the impression that

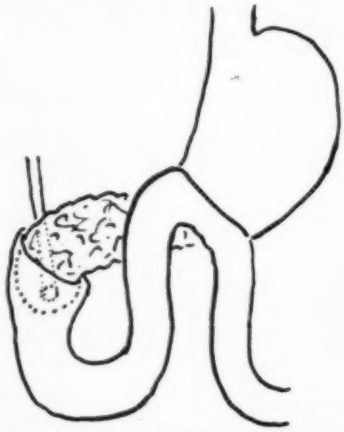


FIG. 804.—Diagram of method of restoration of continuity. The head of the pancreas containing the cut end of the common bile-duct has been sutured into the open end of the jejunum. An end-to-side gastrojejunal anastomosis has been performed.

the ulcer which subsequently proved to be benign was a carcinoma.

Histologically, the cylindrical-cell adenocarcinoma arising from duodenal mucosa shows a tendency to change to a squamous or spheroidal-cell type, which may make it difficult to determine the precise origin of the growth (Maingot, 1936).

Suitable resection of a supra-ampullary carcinoma may be accomplished by a gastrectomy on the same lines as for peptic ulcer.

Early carcinomas of the ampulla can be successfully excised locally from within the duodenum, the bile and pancreatic ducts being sutured to the duodenal mucosa. If the growth has spread to the head of the pancreas, the same operative procedure will be required as for primary carcinoma of the pancreas.

In the infra-ampullary region, adequate resection may be completed by end-to-end anastomosis. By

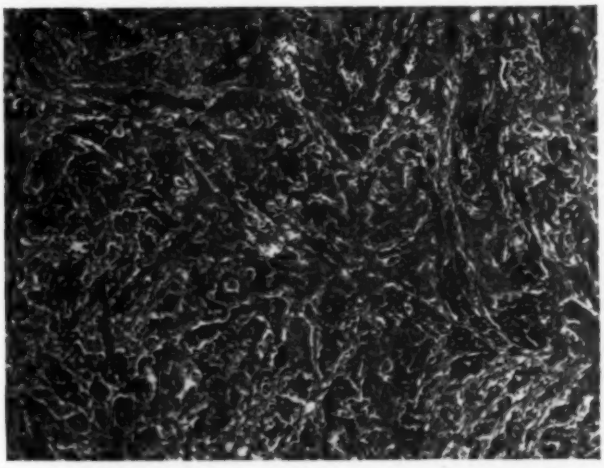


FIG. 805.—Photomicrograph of the tumour showing the irregular mass of trabecular spheroidal-cell carcinoma. (× 180.)

local spread, however, carcinomas arising anywhere in the duodenum may encroach upon the ampulla, necessitating its inclusion in the resection and implantation of the bile and pancreatic ducts into the bowel.

Duodenal carcinomas metastasize comparatively late, and therefore offer a fairly hopeful prognosis if the radiological appearances permit of an early diagnosis and if the technical problems are successfully solved.

It may be anticipated that more cases will come to light at an operable stage now that symptoms of indigestion are regularly subjected to expert radiological investigation.

SUMMARY

A case of carcinoma of the third part of the duodenum is reported.

Gastroduodenal resection and implantation of the head of the pancreas into the jejunum was successfully performed.

I am indebted to Dr. J. L. Hamilton-Paterson for the histology and to Miss M. H. Shaw, A.I.D.P., for the photograph of the operation specimen.

REFERENCES

BARCLAY, S. (1946), *N.Z. med. J.*, **45**, 561.
BEATTIE, W. M., and MUIR, J. D. (1949), *Brit. J. Surg.*, **36**, 436.
DUNHILL, T. (1952), *Ibid.*, **40**, 5.
FORTY, F. (1949), *Proc. R. Soc. Med.*, **42**, 862.
— — and BARRETT, G. M. (1952), *Brit. J. Surg.*, **40**, 60.
LUNN, G. M. (1952), *Ibid.*, **40**, 5.
MACINDOE, P. H. (1940), *Med. J. Aust.*, **1**, 48.
MAINGOT, R. (1936), *Postgraduate Surgery*, **1**, 603.
ROGERS, K. E., GOLIGHER, J. C., and WILLIAMS, E. R. (1952), *Brit. J. Surg.*, **40**, 5.

MECKEL'S DIVERTICULUM WITH MESENTERIC ABSCESS

By DAVID DUNCAN

SENIOR CASUALTY OFFICER, CUMBERLAND INFIRMARY, CARLISLE

PERFORATION of a Meckel's diverticulum may result from strangulation, peptic erosion, or acute inflammation, and usually causes widespread peritonitis. In a case encountered recently an acutely inflamed diverticulum had perforated into the substance of the mesentary of the ileum.

CASE REPORT

A previously healthy man of 43 years developed central abdominal pain and vomited; the pain persisted on the second day but he was able to sleep. He had no appetite. On the third day he ate a little but vomited again. The bowels moved normally. The pain became localized to the right of the umbilicus and grew worse, preventing sleep.

There was now marked tenderness to the right of the umbilicus, with muscle guarding and rebound tenderness on the fourth day. He was admitted to hospital and a diagnosis of acute appendicitis was made. At operation the same day, a hyperæmic appendix was removed through a muscle-splitting incision in the right iliac fossa. A large inflammatory mass encountered by the exploring finger was then delivered through a right paramedian incision. There was a mesenteric abscess 5 cm. in diameter with a Meckel's diverticulum firmly fixed to its posterior surface (*Fig.* 806). The diverticulum was 40 cm. from the ileocæcal valve, and was excised together with the affected mesentery and the adjacent bowel.

Continuity of the ileum was restored by end-to-end anastomosis, and the patient returned to work as a labourer a month later.

PATHOLOGICAL REPORT.—The tip of the Meckel's diverticulum was acutely inflamed and its lumen was continuous with the cavity of the mesenteric abscess. A large, hard enterolith lay free in the abscess cavity (*Fig.* 807). The surrounding mesentery and the associated bowel were congested and œdematous.

FIG. 806.—The tip of the Meckel's diverticulum was attached to the posterior surface of the mesentery.

FIG. 807.—Cavity of mesenteric abscess, containing enterolith.

DISCUSSION

The attachment of the diverticulum to the mesentery appeared too firm to have occurred during the recent illness, and it seems likely that prolonged fixation of the diverticulum by congenital adhesions may have permitted stagnation of its contents and formation of the stone. In the absence of previous symptoms it is improbable that the stone originated in the gall-bladder, but it could have arisen in the intestine before becoming lodged in the diverticulum. Fowweather (1955) has shown that enteroliths may consist mainly of bile-acids, or calcium oxalate, or phosphate, and he attributes their normally laminated structure to changes in the supply of precipitated material and changes in the *p*H of the bowel contents. The finding of an enterolith associated with a Meckel's diverticulum is unusual, and is not mentioned by McFarlane (1948) or Ward-McQuaid (1950) in discussing foreign bodies harboured by these diverticula and causing perforation.

SUMMARY

The unusual occurrence of an enterolith and a mesenteric abscess in association with a Meckel's diverticulum is described. The specimen is exhibited in the museum of the Royal College of Surgeons of Edinburgh.

I am grateful to Mr. J. E. Monro for his advice, and to Dr. A. Inglis for the pathologist's report and the photographs.

REFERENCES

FOWWEATHER, F. S. (1955), *Brit. med. J.*, **2**, 1010.
MCFARLANE, D. A. (1948), *Brit. J. Surg.*, **35**, 421.
WARD-MCQUAID, J. N. (1950), *Lancet*, **1**, 349.

A CASE OF UNSUSPECTED ARTERIAL DISEASE

By G. F. HENSON
SENIOR REGISTRAR, PADDINGTON GENERAL HOSPITAL

THE possibility of peripheral vascular disorders masquerading as orthopædic conditions is well recognized and should lead to an examination of the vascular system where such possibilities exist. The coexistence, however, of orthopædic and peripheral vascular lesions may result in the failure to detect the double pathology and to concentrate on the more obvious disorder, sometimes with disastrous results, as the following case report illustrates.

CASE REPORT

A married man, aged 35, was admitted to Paddington General Hospital complaining of a deformity of his fifth right toe. This had been present since childhood, but

FIG. 808.—Arteriogram showing occlusion of the main vessels in the right leg.

he had managed to get around for many years without discomfort, albeit with difficulty in finding comfortable shoes. He now complained of pain in the toe, which he ascribed to the recent development of corns and their constant irritation by his shoes. He had no other symptoms and indeed general examination, which at this time did not include the peripheral vascular system, showed him to be an apparently healthy patient. The local condition was one of dorsal displacement of the right fifth toe, which was overlying the fourth toe and the site of the corns of which he complained. This therefore appeared to be a simple orthopædic disorder and in view of the long history of the deformity, it was decided to amputate the toe rather than attempt reposition. The toe was removed by disarticulation through the metatarso-phalangeal joint.

Operation gave the first clue that all was not well, there being remarkably little bleeding. From the first post-operative day, the patient complained of considerable pain at the suture line, which was barely controlled by potent sedation. Inspection of the wound showed no sepsis or hæmatoma formation, but the edges displayed the dusky bluish discoloration so characteristic of the avascular wound and it became obvious that his pain was due to ischæmia. Examination of the pulses now revealed that although all other limbs had good peripheral pulses, none could be felt below the level of the popliteal on the operated leg, which was also observed to be cooler than its fellow. On requestioning the patient as to the

FIG. 809.—Arteriogram showing absence of main vessels in the right foot and a very tenuous collateral supply.

presence of any ischæmic symptoms pre-operatively, such as intermittent claudication or pain other than in the toe, he strongly denied any. His wife, however, disclosed that he had been complaining of claudication in the calf and rest pain in the whole foot and leg for the past two months, but had refused to seek medical advice—a story to which the patient ultimately admitted.

An arteriogram (*Figs.* 808, 809) showed the typical changes of Buerger's disease with occlusion of the main vessels about one-half to two-thirds of the way down the leg. An attempt to increase his blood-flow was made by performing a right lumbar ganglionectomy with removal of the 2nd, 3rd, and 4th ganglia. This resulted in warming of the limb and anhidrosis to the level of the knee, with a complete disappearance of pain. At the same time, the patient, who had previously smoked twenty cigarettes a day, very promptly stopped smoking and after an initial delay to prevent hæmatoma formation in his wound, he was put on a long-term course of anticoagulant therapy. At this stage the appearances of the foot were as in *Fig.* 810.

Subsequently it became necessary to trim the protruding metatarsal, but in spite of bony healing, the skin wound remained absolutely unhealed and defied all efforts to skin-graft it. Gradually the patient's rest pain returned, became intolerable, and in the presence of a good popliteal pulse, a below-knee amputation was performed with good healing and an end to his pain.

FIG. 810.—Photograph of the right foot showing the breakdown of the wound with gangrene of the edges after local amputation.

DISCUSSION

The pain of which this patient complained, although apparently due to recurrent minor traumata to a displaced toe, was almost certainly due to unappreciated ischæmia. While a toe subject to repeated injuries in an ischæmic limb would almost inevitably have become gangrenous, the surgical interference precipitated these changes. It is possible, although unlikely in view of the arteriographic appearances, that an initial ganglionectomy might have forestalled such changes or even produced satisfactory healing following local amputation. What the outcome might have been with different treatment in this particular case must be a matter of conjecture, but it is not difficult to visualize circumstances where a conservative policy in the treatment of minor orthopædic disabilities of the foot would not only be possible but might avoid a real risk of gangrene with all its consequences. For instance, a patient might present with a degree of hallux valgus which normally would warrant surgical intervention, although pressure from the bony exostosis could be prevented by the application of a suitable pad of felt plaster. In the presence of arterial disease the latter course would undoubtedly be the method of choice. Patients suffering from occlusion of main vessels can be identified by the simple expedient of feeling the pulses.

CONCLUSIONS

Sometimes an obvious orthopædic lesion may mask or detract from a coexisting peripheral vascular lesion which may be of far greater importance. Following discussions resulting from the case reported above, the writer believes this state of affairs to be less readily recognized than the vascular disease which mimics an orthopædic condition. With deference to those whose practice it already is, the purpose of this case report is to stress the importance of palpating the peripheral pulses before operating on the foot, irrespective of the presenting local signs and symptoms. No operation should be undertaken on the foot without due consideration for its blood-supply.

I wish to thank Mr. J. L. Stephen for permission to publish this case; and the Photographic department at St. Mary's Hospital, London, for the photographs.

A CASE OF FÆCAL CONTAMINATION OF THE PLEURA AND GASTRO-COLIC COMMUNICATION FOLLOWING GUNSHOT INJURY

BY GERSON KATZ

THORACIC SURGICAL UNIT, JOHANNESBURG GENERAL HOSPITAL

FÆCAL soiling of the pleura is rarely seen in civilian practice and the unusual findings in this case with survival when treated twelve days after injury warrant this record.

CASE REPORT

The patient, M. V., a 12-year-old boy, was admitted to the Children's Hospital, Johannesburg, on July 27, 1955, twelve days after an accidental gunshot injury. The entry wound was over the xiphoid tip and the exit wound was in the left seventh intercostal space at the level of the posterior axillary line. He had been admitted to a country hospital 150 miles distant, where multiple aspirations of the left pleural space were performed and because of progressive deterioration in his condition his transfer to a Thoracic Unit was advised. For the first three to four days following injury he had complained of severe pleuritic pain in the left chest, which had then become less severe and was now only dull in character. Initially there had also been some pain in the left loin and left shoulder, which had subsided after thirty-six hours, but no abdominal pain had been experienced. Intermittently since the injury he had had diarrhœa, with days when the stool was normal in character, but on the day of his admission the diarrhœa had become worse and four to five watery stools had been passed.

When seen he presented as an extremely shocked patient. The pulse-rate was 140, respirations 48 per minute, blood-pressure 80/50, and temperature of 101·4. The mucous membranes were anæmic and the jugular venous pressure was raised to the angle of the jaw. The trachea was markedly deviated to the right, with signs of a tension hydropneumothorax on the left side. There were many moist sounds in the region of the right lower lobe. The abdomen was moderately distended, but there was no tenderness or guarding in any quadrant. Active bowel sounds were present. There was pitting œdema of the ankles and tibiæ as well as sacral œdema. A radiograph obtained by a portable X-ray unit confirmed the physical findings, revealing a totally atelectatic left lung and compression of the right lung by a gross

mediastinal shift (*Fig.* 811). There was no evidence of diaphragmatic hernia. A scout film of the abdomen showed no fluid levels, no air under the diaphragm, and no free fluid.

The left pleural space was decompressed by means of an intercostal catheter inserted into the second left interspace anteriorly and 400 c.c. of brownish-red malodorous fluid with flakes of fibrin drained into an underwater seal and air bubbled off with coughing. The trachea became central after decompression, but with the drainage of a further 1000 c.c. of fluid together with the presence of a continuous air leak it was now obvious that a bowel injury was present. An ounce of water containing 1 c.c.

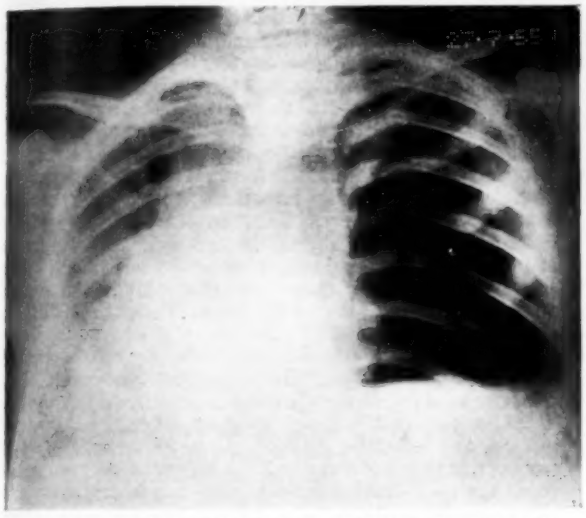


FIG. 811.—Bedside radiograph on admission, showing a left tension hydropneumothorax with gross mediastinal shift.

of methylene blue was given by mouth, but no discoloration of the pleural drainage was noted immediately. At this stage a watery stool was passed in the bed, resembling the pleural drainage, and this suggested the origin of the thoracic contamination. An attack of extreme breathlessness with increase in the moist signs in the right lung associated also with bronchial spasm now occurred. Aminophyllin intravenously and mersalyl 1 c.c. intramuscularly were given and the boy was bronchoscoped urgently in the ward, when much frothy and mucoid secretion was aspirated from the bronchial tree. On the way to the theatre methylene blue appeared in the pleural drainage and another diarrhœic stool was voided which contained methylene blue. This occurred about forty-five minutes after the dye had been given by mouth.

AT OPERATION.—The left chest was opened through the eighth intercostal space. The left lung was encased in a fibrinous cortex and was adherent on the mediastinum. The parietes were grossly soiled with a fibrinous fæcal exudate. A bullet hole was present in the diaphragm situated laterally, through which the splenic capsule could be seen and through which gastric and colonic fluid welled. The diaphragm was incised radially from the site of the bullet wound, exposing stomach and splenic flexure. The bullet had traversed the spleen, which was found shattered, and splenectomy was first performed. A gastric and two colonic perforations were identified, and it was then obvious that the stomach had been emptying its content into the colon through the intervening lesser sac. The infection was walled off in the lesser sac and it was for this reason that there had been no evidence of peritonitis clinically. The gastric and colon perforations were oversewn, using interrupted No. 0 Deknatel sutures, and drainage of the lesser sac was established laterally, using a corrugated drain which was brought out in the loin below the left twelfth rib. The diaphragm incision was closed with interrupted sutures of Deknatel No. 2.

The lung was now decorticated and the fibrinous exudate on the parietes removed, following which the

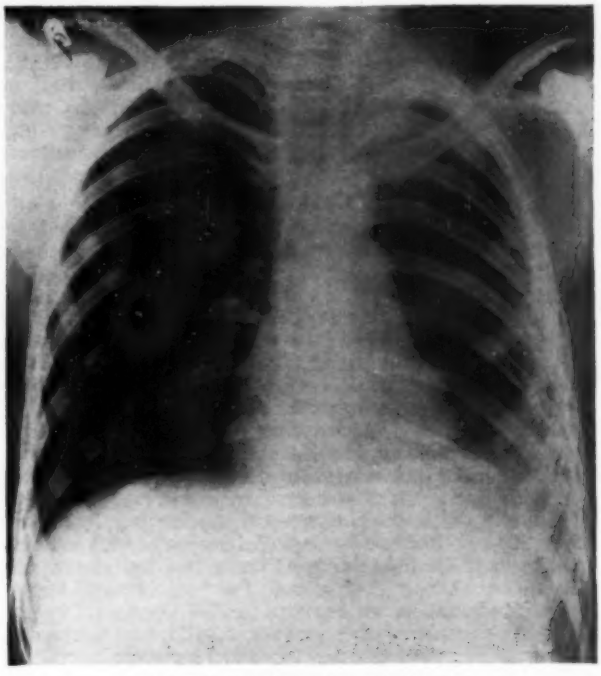


FIG. 812.—Radiograph on discharge.

lung expanded well with positive pressure assistance by the anæsthetist. The chest was closed routinely with an apical and a basal intercostal underwater seal drain.

POST-OPERATIVE PROGRESS.—1000 c.c. of blood was given during operation and in the post-operative period, and fluid, electrolyte, and protein balance was maintained. During the first week there was a marked diuresis as the œdema fluid was excreted and the cardiac failure and electrolyte and protein disturbance secondary to the gastrocolic 'fistula' was corrected. The radiograph on the first post-operative day showed the left lung well expanded and filling the left hemithorax. The intercostal drainage-tubes were removed on the third post-operative day. A fæcal fistula developed a week post-operatively which discharged at the site of the lesser sac drain in the loin. This closed spontaneously after three weeks. Despite early re-expansion of the left lung a loculated *B. coli* empyema developed which required multiple aspirations and antibiotic sterilization. This, with active physiotherapy, soon controlled the residual infection and the empyema had healed and the lung was well expanded at the time of discharge from hospital six weeks post-operatively (*Fig.* 812).

COMMENT

In a country where distances are great and the facilities of special units are not easily available, delay of this nature will occur. It is of interest, however, that with gross fæcal soiling of twelve days' duration decortication will allow of satisfactory pulmonary re-expansion and early healing of an empyema. This was possible in this patient in the presence of cardiac failure, pulmonary œdema, and electrolyte imbalance.

REVIEWS AND NOTICES OF BOOKS

Modern Trends in Orthopædics. (Second Series.) Edited by Sir HARRY PLATT, LL.D., M.D., M.S., F.R.C.S., F.A.C.S., President, Royal College of Surgeons of England; Emeritus Professor of Orthopædic Surgery, University of Manchester; etc. 9½ × 6½ in. Pp. 331 + x, with 226 illustrations. 1956. London: Butterworth & Co. (Publishers) Ltd. 65s.

THIS second volume on orthopædics, again edited by Sir Harry Platt, dispels any doubts there may have been about the propriety of publications of this kind, collections of essays on arbitrarily chosen topics. What gives this book so irresistible an appeal is that (with two possible exceptions) every contributor writes about a subject that he has made his own and that still excites his enthusiasm. There is an easy confidence, an urbanity about these essays that make reading them a pleasure. The Editor himself sets the standard in his essay on congenital dislocation of the hip, in which he sums up an experience surpassed in this country only by Fairbank's; he sets out with great clarity the present and still unstable situation in the management of this fascinating deformity. Most of the other essays are nearly equally well written, and it would be interesting to know to what extent this was due to skilful editing or to the contributors' knowledge of what their master expected of them.

In this country the surgery of the knee-joint has been worked out so thoroughly that the topic is becoming a little hoary; but Bonnin brings it to life again and with admirable brevity. Capener's article is unusual in that it deals in a general way with the mechanics of reconstructive surgery of the hip. This should be a set piece for all orthopædic registrars. J. N. P. Clark on muscle and tendon transposition in poliomyelitis has managed to achieve remarkable detachment. No one is keener than he in this field of surgery and in none are surgeons more prone to have strong preferences for this or that operation. Holdsworth brings up to date his excellent work on traumatic paraplegia and Seddon presents his case for regarding anterolateral decompression of the cord as the only reliable remedy for severe Pott's paraplegia.

The standard of production of the book is an improvement on that of the first volume, but there are a few irritating blemishes: radiographs upside down, inaccurate references, and curious gaucheries such as acknowledgements to British surgeons who are described as Dr. These should be tidied up if, as we hope, an early reprinting is called for.

Outline of Orthopædics. By JOHN CRAWFORD ADAMS, M.D. (Lond.), F.R.C.S. (Eng.), Consultant Orthopædic Surgeon, St. Mary's Hospital, London, etc. 8½ × 5½ in. Pp. 423 + viii, with 299 illustrations. 1956. Edinburgh: E. & S. Livingstone Ltd. 32s. 6d.

THE surgical curriculum must include a good deal about disorders of the locomotor system and the undergraduate requires a suitable text. Over many years it has been usual to put everything together in a general text-book of surgery, and there is still much to be said for this because the principles of diagnosis and treatment are much the same for all surgical conditions. So far as the student is concerned most text-books of orthopædics have failed because they have become too large. Mr. Adams believes that the student needs a short "line out" of orthopædics. His book covers the field very adequately, though fractures are excluded.

Disorders of the limbs and spine are considered first in a general way and then regionally. Emphasis is laid on methods of examination, and this part of the text is excellent. There is little about the principles of treatment. Maybe this is right, because the most that should be expected of the undergraduate is how to recognize orthopædic conditions, not to treat them. An extraordinary amount of information has been compressed into 411 pages. That in the general section is good. But there might have been more condensation in the regional section, particularly details about treatment. Operations for congenital dislocation of the hip might have been given only a few lines; the treatment of tuberculous joints is repetitious, for the régime is much the same whatever the site of the disease; the treatment of slipped upper femoral epiphysis could have been dealt with very briefly. Reference to some conditions might have been omitted altogether—e.g., Pellegrini-Stieda's disease and Paget's disease affecting the tibia.

The medical student of to-day is being overwhelmed with factual knowledge. His salvation can come only from those who frame the curriculum, teach, and examine. But the writers of books for students have their part to play, too, and it is the easiest. Is it too much to hope for an outline that really is one? There are many comprehensive texts to which the inquiring youth can turn for information about the unimportant or the rare condition.

Manual of Hand Injuries. By H. MINOR NICHOLS, M.D., University of Oregon Medical School, Portland. With a Foreword by MICHAEL L. MASON, M.D. 8⅞ × 5⅞ in. Pp. 352, with 180 illustrations. 1955. Chicago: Year Book Publishers Inc. (London: Interscience Publishers Ltd.) 72s.

"THE past 25 years have seen surgery of the hand develop from a concern largely of the general surgeon in a struggle to combat infection to an extensive and varied field."

The publications by Kanavel from 1906 in various journals up to that of his book in 1912 on *Infections of the Hand*, while in no way being the first to draw attention to the importance of surgical procedures in this region, did stimulate by the details of the anatomy of the hand, and various newly conceived operations, and establish its importance to such an extent that special 'Hand Clinics' under a specially trained team is now regarded as necessary in any casualty department, especially so in industrial centres.

Recently the work of Bunnell and his associates has developed the reconstructive procedures in traumatic cases still further, which with the assistance of the plastic surgeon should make what has been called the useless 'pudding hand' after injury a thing of the past. The importance of these cases being especially treated by a team of experts as soon as possible after the injury until the end of the treatment has recently been summed up by a prominent industrialist: "I do not worry now so much about the fractures of long bones occurring among my employees; a large number ultimately come back and do useful work. My worry now is the man who has had a slight head injury, insufficient to produce concussion, and the man who has had an injury to his hand which is not considered sufficiently serious to send to hospital until about the fifth day or later when 'it has

gone septic'. Neither ever do really useful work again."

In the preface to the present book the statement quoted of the late Dr. Horner D. Dudley that "success in treating a severe hand injury requires more skill and exacting judgement than an elective abdominal operation" will be echoed and agreed to by most surgeons interested in the treatment of trauma.

The arrangement of the various sections of the book indicates to the surgeon the method of approach to these cases.

First the anatomy of the part injured and the probable consequences, then the general principles of pre- and post-operative care, followed by the treatment of various injuries to different tissues and the complications, finally ending with a chapter on elective and reconstructive procedures. The obvious but little appreciated truth that the best dressing for any wound is *skin* is stressed throughout.

The book should find a place on the shelf of every hospital library where a young house surgeon, or even the senior surgeon, can take it down for a desultory half-hour's perusal which will end by a careful reading of the text. The illustrations are extremely good.

Chirurgie des Glandes Salivaires. By HENRI REDON, Paris. 9¼ × 6¾ in. Pp. 281 + iv, with 77 illustrations. 1955. Paris: Masson et Cie. Paper, 2,300 fr.; Cloth, 2,900 fr.

THE surgery of the parotid was long held up by fear of the facial nerve, and by lack of a standardized technique for removal of the parotid with preservation of the nerve. The development of the modern operation of conservative parotidectomy has remedied this, and as a result the surgery of the parotid has recently taken big strides forward. In this advance, French surgery has been well to the fore, with Redon as its acknowledged leader. The publication of this monograph by Redon is thus an important event.

Though the title refers to the salivary glands in general, the main interest is concentrated on the parotid, discussion of which occupies 241 of the 268 pages of the text. It is clear, too, that the author's main interest is in the tumour problem, and, though there is an excellent chapter on parotid lithiasis, the account of the inflammatory conditions is largely a catalogue of syndromes. This latter part suffers from the disadvantage of being written without knowledge of the recent English work on the pathology of so-called 'sialectasis'. But it is largely for the author's work on tumours that the surgeon will want to consult this book, and he will be richly rewarded. One can summarize by saying that there is hardly an aspect of the problem of parotid tumours that the author has not illuminated by the light of his extensive experience.

Criticism is limited to occasional points of detail. Thus though multiplicity of recurrent mixed parotid tumours is generally recognized, Delarue's pathological evidence relied on by Redon on the frequency of multiplicity of primary mixed parotid tumours does not satisfy at any rate the present reviewer, nor accord with his experience. On the other hand, Delarue seems to have missed the frequent multiplicity of adenolymphomata which has been the reviewer's experience, so that Redon on balance advises merely enucleation for these tumours, which seems to the reviewer to be illogical. But no doubt Redon and Delarue would regard these points as arguable, and in the case of the adenolymphomata at any rate there is a hint at the end of a change of opinion.

This is undoubtedly a work which should be read by all surgeons interested in the surgery of the parotid, and the stiff covers, so exceptional in French monographs, will certainly be needed in view of the frequency with which the work will be consulted. There is a fairly good bibliography, and also an index, another novel feature in a French monograph. Altogether it is a particular pleasure for the many British surgical friends of France to note this further evidence that French surgery is once again taking its rightful place in the van of surgical progress.

Le Cancer du Plancher de la Bouche. By MARCEL DARGENT and JEAN PAPILLON, with the collaboration of J.-F. MONTBARBON. With a Foreword by P. SANTY. 9¾ × 6¾ in. Pp. 169 + vi, with 48 illustrations. 1955. Paris: Masson et Cie. 1,800 fr.

THIS is an important work by a surgeon and a radiotherapist of the Lyons school, in which the authors analyse their own carefully documented and extensive material of 454 cases against the background of a very full and scholarly review of the work of others in the same field. All aspects of the subject are discussed, and the book will probably have and will certainly deserve a wide circulation. In the early chapters, the authors give the evidence which leads them to believe that alcoholism is a factor in carcinoma of the floor of the mouth, during which the astonishing fact emerges that in 90 per cent of their patients with this disease the average daily consumption of wine was between two and three litres a day. Another interesting general point is the frequency of the development of second primary carcinomas, particularly in the œsophagus, in patients cured of the original lesion. The technique, indications, results, and complications of a wide variety of types of treatment are discussed. In the treatment of the primary lesion the authors have developed electrocoagulation more than most other centres. In the neck they are in favour of a block dissection on principle, and quote in support of this procedure the fact that in 81 cases with no glands palpable microscopical invasion was found in 21. In these cases they advocate an interesting modification of block dissection in which the spinal accessory nerve is preserved. The criticism, often with justification, made against French medicine that it takes no note of work done outside France cannot be made in this case. There is an excellent bibliography of the world literature. Incidentally, they favour the American model of giving the titles of all articles, which makes a bibliography so much more valuable. Perhaps this habit will soon cross the channel.

Roentgen Interpretation. By GEORGE W. HOLMES, M.D., Hon. Physician, Massachusetts General Hospital, etc.; and LAURENCE L. ROBBINS, Radiologist in Chief to the Massachusetts General Hospital; etc. Eighth edition. 9¼ × 6 in. Pp. 525, with 371 illustrations. 1955. London: Henry Kimpton. 72s. 6d.

IN this, the eighth edition of the handbook of radiology made famous under the authorship of Holmes and Ruggles, Dr. Laurence Robbins has taken over joint authorship. The great popularity of this book, which is too full for the general medical reader, and not full enough for the young radiologist, remains something of a mystery, and must be attributed to the skill of the authors in presenting their material. It is a pleasing book to read, is not verbose, and contains little of the padding so popular in some transatlantic text-books. In the space available—one volume of 500 pages—the authors have given an excellent survey of the scope of modern diagnostic radiology.

The section on the bones and joints is admirable, well-balanced, and contains an informative analytical table of findings in bone tumours. The chapter on the gall-bladder is rather sketchy, to the extent that in neither

oral nor intravenous cholecystography is the contrast medium named. Some of the illustrations are clear and of good quality, others suffer from being printed as negatives. In general, the book is to be recommended to those who want to learn something of diagnostic radiology. For those who intend to practise that specialty it will serve as an introduction.

Management of Pain in Cancer. Edited by M. J. SCHIFFRIN, Ph.D., Chicago. With a Foreword by WARREN H. COLE, M.D. $6\frac{7}{8} \times 4\frac{3}{4}$ in. Pp. 245, with 10 illustrations. 1956. Chicago: Year Book Publishers Inc. (London: Interscience Publishers Ltd.) 33s.

THIS small pocket-book, devoted to the management of the patient who is dying of malignant disease, contains a very fair survey of the various forms of treatment that are available at the present time.

It is surprising that under the heading of systemic analgetics many and varied drugs are advised but there is no mention of heroin, which seems strange—but this is no doubt due to its manufacture being prohibited in the States.

The value of nerve-blocks, neurosurgical operations, and humoral and chemical palliation are dealt with in an interesting manner.

The various surgical procedures and radiation therapy in the treatment of pain in the cancer patient are discussed in detail.

This book will interest the general practitioner more than the physician or the surgeon.

Surgery of the Ambulatory Patient. By L. KRAEER FERGUSON, M.D., F.A.C.S., Professor of Surgery, University of Pennsylvania; etc. With a section on Fractures by LOUIS KAPLAN, M.D., F.A.C.S., Senior Attending Surgeon, Albert Einstein Medical Center, Southern Division; etc. Third edition. 9×6 in. Pp. 866 + xxvii, with 664 illustrations. 1955. Philadelphia: J. B. Lippincott Co. (London: Pitman Medical Publishing Co. Ltd.) 96s.

THE extent of 'out-patient' surgery varies inversely with the cost and availability of hospital beds. Whilst some of the procedures described here might be thought ambitious for ambulatory patients, yet for those surgeons and practitioners who are prepared to follow the technique recommended in this book there is ample work to be done and many beds to be saved for patients who cannot be ambulant.

This third edition has been revised and enlarged in several particulars; it is a major treatise on minor surgery.

Clinical Neurosurgery. Proceedings of the Congress of Neurological Surgeons, New York, N.Y., 1954. 9×6 in. Pp. 173 + x, with 54 illustrations. 1955. London: Baillière, Tindall & Cox. 54s.

THIS book follows the pattern of the previous volume on clinical neurosurgery noticed in this Journal for September, 1955, and is the second volume of the Proceedings of the Congress of Neurological Surgeons held in the United States in 1954. It consists of five addresses by Dr. K. G. McKenzie, of Toronto, whose portrait appears on the fly-leaf, and concludes with 'panel discussions'. McKenzie's papers consist of his contributions on the intracranial astrocytomas, the acoustic neurinomas, in which he has the assistance of Eben Alexander, jun., spasmodic torticollis, Ménière's syndrome, and trigeminal tractotomy. Reviewing the results of treatment of the astrocytomas he finds the infratentorial tumours of this type are a more favourable group, many having survived for twenty years, than those situated above the tentorium. He also demonstrates the difficulty of classification which arises from the lack of uniformity of type in these tumours. A tumour which in one part appears to be a fibrillary and benign type may elsewhere be typically malignant. The contribution on tractotomy, with a discussion by F. C. Grant, should be read not only by clinicians but by all who are interested in the anatomy of the nervous system. The concluding chapters of the book are on injuries to the cervical spine and the medico-legal aspects of head injuries. The book is a well-deserved tribute to Dr. McKenzie and his work, and will be appreciated not only by his old students and those who have been associated in the work of his clinic, but by neurologists everwhere.

Alfred Hospital: Clinical Reports, 1955. Edited by R. S. LAWSON. $9\frac{3}{4} \times 6$ in. Pp. 125 + vi. Illustrated. 1955. Melbourne: The Alfred Hospital.

ALTHOUGH this is the fifth volume of the Clinical Reports from the Alfred Hospital in Melbourne, it is very fitting that the Editor should in the preface explain to his readers how the hospital got its name. He proceeds: "Few people in Melbourne to-day are familiar with the history of Prince Alfred, after whom the hospital is named. The name adorns a sister hospital in Sydney and a well-known school in Adelaide, and to this day there are thirty streets and half a dozen hotels in Melbourne itself still called after Prince Alfred, Duke of Edinburgh."

From reading the preface to this report it is clear that though apparently few Australians are aware of whom he was, yet there must be *very few* surgeons elsewhere who have even an inkling of his identity. Australia received its first visit from him as Royalty in 1867.

"Alfred Ernest Albert, the second son of Queen Victoria was born at Windsor Castle on 4th August, 1844." He entered the Royal Navy at the age of 14 and as a midshipman visited various parts of the Empire. In 1862 he was offered the Crown of Greece by the people of that country; the offer was declined as the Minister for Foreign Affairs, Lord Palmerston, considered, if accepted, it would give offence to France and Russia.

In 1866 he was created Duke of Edinburgh, Earl of Ulster and Kent. He was commissioned as Captain R.N. in command of H.M.S. *Galatea*, which vessel thereafter set sail on a world tour under his command. The tour commenced in January, 1867, visiting Brazil, Tristan da Cunha, and Cape Town. The first port of call in Australia was Adelaide, at that time having a population of 23,000, and on Nov. 23, 1867, he visited Melbourne, which then had a population of 150,000, the largest city in the whole continent. "Triumphant arches abounded in every part of Melbourne, while even the entrance gates to the Yarra Bend Lunatic Asylum were surmounted by a great arch with the words 'Welcome Alfred'. He later laid the foundation stone of Melbourne Town Hall."

The Duke spent six weeks in Victoria and then sailed for Tasmania, then to Sydney, and on to Brisbane. He returned to Sydney and on March 10, 1868, an attempt was made to assassinate him, but the wound in the back proved not to be serious. His convalescence was smooth and on April 4, 1868, he laid the foundation stone of the Sydney Town Hall. It was the attempted assassination that stimulated the idea to erect an 'Alfred Memorial' Hospital in Melbourne and also in Sydney. He became Commander-in-Chief of the Mediterranean Squadron in 1889. In August, 1893, he succeeded his uncle to the Duchy of Saxe-Coburg-Gotha and died at Rosenau, near Coburg, in July, 1900. Later on this year another Duke of Edinburgh, our Duke, is to make an almost identical tour to that which ninety years ago was made by the

first member of the Royal family who visited Australia and various isolated islands in the Antipodes. He may also lay foundation stones, but he will certainly inaugurate the Olympic Games, which though encouraging the rivalry of nations in one respect, should be such a great factor in securing peace and good fellowship.

It is a well-recognized and important custom in all industrial concerns that a careful stocktaking should be carried out at frequent intervals. It is equally important that clinical reports should be published regularly by all great teaching hospitals and thereby establish a stock-taking. It is not necessary to remind readers of the valuable, even epoch-making, articles which have been made in the annual reports published by the staffs of hospitals in this country. The present volume contains two valuable critical reviews over periods of ten years of carcinoma in the colon and rectum, and a third on the importance of Trousseau's opinion that venous thrombosis might be a sign of malignancy, and first described by him in 1869. The other articles deal with subjects which are closely related to biochemistry and more strictly deal with clinical medicine rather than surgical procedures, and quite properly two articles deal with rare conditions such as a ' bifid cardiac apex ' and unusual clinical conditions produced by gout.

The illustrations in the volume are extremely good. Its perusal may quite well stimulate the staffs of other hospitals to ' face up ' to some of the disturbing facts which may emerge from an honest stocktaking.

Advances in Pediatrics. Vol. VIII. Edited by S. Z. LEVINE, Cornell University Medical College, New York. 8¾ × 5¾ in. Pp. 273. Illustrated. 1956. Chicago: Year Book Publishers Inc. (London: Interscience Publishers Ltd.) 62s.

OF the previous seven volumes of this composite work, numbers I, II, and IV are already out of print. This number contains articles on infantile diarrhœa, sexual precocity in boys, sarcoidosis, the children of parents with diabetes, subdural lesions, the prevention of accidents in childhood, and mental deficiency. In the section on precocity in boys a case record of early puberty due to a sacral teratoma producing pituitary gonadotropins is believed to be the first of its kind to be reported. The book is edited by Dr. S. Z. Levine, of Cornell, with the assistance of associate editors from San Francisco, Cincinnati, Washington, Columbus, Ohio, and New York respectively. The contributors are equally widely distributed from New Orleans to North Carolina, and Kansas to Connecticut. Each contribution is well documented and some, but not all, have summaries and conclusions. Condensation has been great and in some cases concentration is extreme; thus the relatively brief article on diarrhœa summarizes 116 references and the even shorter one on sarcoidosis 196. The book contains a number of plates and a few black-and-white figures and diagrams. It should have a wide appeal to all who are interested in disease in children.

Thomas Fairbank Birthday Volume. *Journal of Bone and Joint Surgery*, Vol. 38B, No. 1, February, 1956, Pp. 436 + iv. Edinburgh: E. & S. Livingstone Ltd. Paper cover, £2; canvas cover, £2 5s.

WE should like to congratulate Sir Thomas Fairbank on becoming an octogenarian and having such an interesting volume presented to him on his eightieth birthday. In the past many birthday volumes have been published, but this one outshines them all in many respects.

St. J. D. Buxton gives us an excellent account of Sir Thomas as a man and as an orthopædic surgeon; he also recounts the variety of work which was undertaken by Fairbank in the various hospitals in which he worked. A chronological list of Fairbank's contributions to surgical literature is also given, and this in itself is most useful for reference purposes.

There are some thirty-six contributors to this birthday volume, all experts in their own special field, all writing on orthopædic subjects.

The illustrations in this volume of 436 pages are superb and the coloured ones are truly excellent and could not be bettered, and the photomicrographs are beautifully reproduced.

We feel that Sir Thomas must be proud that such a volume should be presented to him, for it contains all that is best in orthopædic surgery and is a credit to British surgery.

We would like to congratulate Messrs. E. & S. Livingstone on the excellence of the production of the volume.

Chest X-ray Diagnosis. By MAX RITVO, M.D., Assistant Clinical Professor of Radiology, Harvard Medical School. Second edition. 10 × 7 in. Pp. 640, with 426 illustrations. 1956. London: Henry Kimpton. £6.

THAT a second edition of this large monograph is required after four years speaks for itself. This new edition has been very thoroughly revised and many new illustrations have been added; they are all uniformly good and have been well chosen.

The section on congenital heart disease has been greatly expanded and is excellently written.

The book as a whole is a monumental work and contains all that is known about the X-ray appearances of thoracic conditions.

As a reference volume it could not be bettered.

A Manual of Practical Obstetrics. By the late O'DONEL BROWNE, M.B., M.A.O., M.A., Litt.D., F.R.C.P.I., F.R.C.O.G., Master, Rotunda Hospital, Dublin. Edited and largely re-written by J. G. GALLAGHER, M.D., M.A.O., F.R.C.P.I., M.R.C.O.G., Assistant Gynæcologist, Mater Hospital, Dublin. Third edition. Pp. 265 + viii, with 205 illustrations. 1956. Bristol: John Wright & Sons Ltd. 37s. 6d.

THE third edition of this popular manual was being prepared by O'Donel Browne immediately before his untimely death. His successor, Dr. J. G. Gallagher, the new editor, has almost re-written the book and we are sure it will be as popular as the former editions.

Basic Surgical Skills. A Manual with Appropriate Exercises. By ROBERT TAUBER, M.D., F.A.C.S., Assistant Professor of Gynecology and Obstetrics, The Graduate School of Medicine, University of Pennsylvania; etc. 10¾ × 7¾ in. Pp. 75 + viii, with 51 illustrations. 1955. Philadelphia and London: W. B. Saunders Co. 26s.

IN the author's opinion, " the technique of the surgical elements which compose each single step of the operation must be completely mastered before any work in the operating room can be accomplished ". " The surgeon must train his fingers in a similar way as a musician—by persistent practising of well-selected exercises."

For this training he has invented the *training board*, and he advises practice on this board in order to save time in the operating theatre. This board measures 12 × 11½ × ¾ in. It is furnished with " a number of holes, nails, rods, and rings which facilitate the exact performance of the various exercises presented in the different sections of the book. There should be available a number of gauze pads, needles of various size and shape, and several spools of thread to serve as suture

material. The instruments necessary to carry out the exercises are a needleholder, a needle forceps, some straight hæmostats, two bridge clamps, a pair of curved scissors, and a knot-holder. The exercises are to be performed first with bare hands and repeated with rubber gloves."

The various sections deal with the making of knots, different types of stitches and sutures, and methods of using hæmostats. All the exercises are beautifully illustrated with line drawings, with very full explanatory captions.

The book is really a thoroughly illustrated manual of simple techniques which is usually obtained in this country by the observant assistant at actual operations. It is useful if studied after the young intern's first period of assisting his competent chiefs.

The final remarks of the author state the obvious fact that the surgeon's skill is his best friend in time of need; therefore surgical technique, like friendship, should be cultivated. He hopes that he has offered "a small contribution to the surgical treatment of many patients who will find permanent recovery through the work of *your hands*, successfully trained with the help of this monograph". However, the fact remains that recovery is more often due to knowing 'when' even more than 'how'.

BOOK NOTICES

[*The Editorial Committee acknowledge with thanks the receipt of the following volumes. A selection will be made from these for review, precedence being given to new books and to those having the greatest interest to our readers.*]

Practical Urology. Case Comments and Late Results. By ALEX. E. ROCHE, M.A., M.D., M.Ch. (Camb.), F.R.C.S. (Eng.), Genito-urinary Surgeon, West London, Royal Northern, and Hounslow Hospitals. 8½ × 5½ in. Pp. 258 + xii, with 132 illustrations. 1956. London: H. K. Lewis & Co. 35s.

Pulmonary Circulation and Respiratory Function. A Symposium held at Queen's College, Dundee. 9¾ × 7¼ in. Pp. 44 + xii, illustrated. 1956. Dundee: University of St. Andrews (Distributors: E. & S. Livingstone, Edinburgh). 12s. 6d.

La Chirurgie pelvienne après Cloisonnement abdomino-pelvien. Cancer utérin, rectal, vésical. By HENRI BOMPART and R. MICHEL-BÉCHET. With a Foreword by Professor A. BRUNSCHWIG. 9¾ × 6¼ in. Pp. 82, with 15 illustrations. 1956. Paris: Masson et Cie. 750 fr.

A Search for Similarities. The Ninth Macewen Memorial Lecture delivered in the University of Glasgow, April 15, 1955. By Sir JAMES LEARMONTH, K.C.V.O., C.B.E., Ch.M., LL.D., F.R.C.S.E., Regius Professor of Clinical Surgery and Professor of Surgery, University of Edinburgh. 8½ × 5½ in. Pp. 34. 1956. Glasgow: Jackson, Son & Co. 5s.

A Manual of Fractures and Dislocations. By BARBARA BARTLETT STIMSON, A.B., M.D., Med. Sc. D., F.A.C.S., Director of Department of Bone and Joint Surgery, St. Francis Hospital, Poughkeepsie, New York. Third edition. 7⅝ × 5⅛ in. Pp. 224, with 97 illustrations. 1956. London: Henry Kimpton. 34s.

The Body Fluids. Basic Physiology and Practical Therapeutics. By J. RUSSELL ELKINGTON, M.D., Associate Professor of Medicine, University of Pennsylvania School of Medicine; and T. S. DANOWSKI, M.D., Renziehausen Professor of Research Medicine, University of Pittsburgh School of Medicine. 9 × 6 in. Pp. 626 + xxii, with 175 illustrations. 1956. London: Baillière, Tindall & Cox Ltd. 80s.

The Casualty Department. By T. G. LOWDEN, M.A., B.M., B.Ch., F.R.C.S., Consultant Surgeon, Sunderland Royal Infirmary. 9⅛ × 6¾ in. Pp. 278 + viii, with 134 illustrations. 1955. Edinburgh: E. & S. Livingstone Ltd. 37s. 6d.

Surgical Diagnosis. By PHILIP THOREK, M.D., F.A.C.S., F.I.C.S., Professor of Surgery, Cook County School of Medicine; etc. With drawings by CARL T. LINDEN, Assistant Professor of Medical Illustration, University of Illinois College of Medicine. 10 × 7 in. Pp. 320 + xii, with 291 illustrations. 1956. Philadelphia and Montreal: J. B. Lippincott Co. (London: Pitman Medical Publishing Co. Ltd.). 96s.

Operative Technic in Specialty Surgery. Edited by WARREN H. COLE, M.D., F.A.C.S., Professor of Surgery and Head of the Department, University of Illinois College of Medicine. Second edition. 9½ × 6½ in. Pp. 967 + xxvi, with numerous illustrations. 1956. New York: Appleton-Century-Crofts Inc. $20.00.

Peripheral Vascular Disorders. Edited by PETER MARTIN, V.R.D., M.Chir., F.R.C.S. (Edin)., Lecturer in Surgery, Postgraduate Medical School, London; R. BEVERLEY LYNN, M.D., F.R.C.S., Assistant Professor of Surgery and Markle Scholar, Medical College, University of Saskatchewan; J. HENRY DIBLE, M.B., LL.D., F.R.C.P., Professor Emeritus of Pathology, University of London; and IAN AIRD, Ch.M., F.R.C.S., Professor of Surgery, University of London; Director of Surgery, Postgraduate Medical School, London. 9¾ × 6¾ in. Pp. 847 + viii, with 450 illustrations. 1956. Edinburgh: E. & S. Livingstone. £5 10s.

An Atlas illustrating the Topographical Anatomy of the Head, Neck, and Trunk. By the late JOHNSON SYMINGTON, M.D., F.R.C.S., F.R.S., Professor of Anatomy, The Queen's University, Belfast. 12 × 19 in. 34 plates on loose cards in cloth-bound holder. 1956. Edinburgh: Oliver & Boyd. £5 5s.

INDEX TO VOLUME XLIII

PAGE

ABDOMEN, gunshot and sword wounds of - 279
Abdominal lesions associated with œsophageal strictures - - - - - - - - 408
Abscess of breast, retromammary - - - 330
— in left loin and fæcal fistula associated with left ureterocolonic fistula - - - - - - 646
— mesenteric, with Meckel's diverticulum - - 664
— thyroid - - - - - - - - - 218
Achalasia of the cardia complicated by œsophageal carcinoma - - - - - - - 413
Aclasis, diaphysial, chondrosarcoma supervening on 85
Acrylic prosthesis in resection of mandible - - 255
Adamantinoma, aetiology and pathogenesis of - 255
Adenoma of anterior foregut region - - - 248
— Brunner's gland - - - - - - - 106
Adenomatoid tumour of epididymis - - - 512
Adrenal, neuroblastoma of, and intraperitoneal hæmorrhage - - - - - - - - 550
AKEHURST, A. C.: Retrograde intussusception. A report of a case and a review of 103 cases in the literature - - - - - - - 207
ALHADEFF, ROBERT, SCOTT, FOSTER, and TAYLOR, SELWYN: A clinico-pathological study of thyroid carcinoma - - - - - - 617
ALLAN, C.: *See* IRVINE, W. T., jt. auth.
Anæmia, megaloblastic, following gastric resection - 422
Anal canal, surgical anatomy of - - - - 51
— region, operative dissection of - - - - 56
ANDERSON, W.: *See* MOFFAT, F., jt. auth.
ANDREW, JOHN: Osteomata of the paranasal sinuses. A report of five cases, with special reference to their treatment - - - - - 489
Aneurysm, bilateral mycotic femoral - - - 374
— coarctation of aorta associated with - - - 365
— discussion of operation for - - - - 97
— failure of ligation to establish cure - - - 95
— as indication for arterial reconstruction - - 454
— of right subclavian artery, excision of - - 94
Angiography, thorotrast, granuloma of neck due to 638
— vertebral, percutaneous lateral atlanto-occipital method - - - - - - - - 1
Antihistamines, inhibitory action of, on canine acid gastric secretion - - - - - - 522
Anus, anatomy of - - - - - - - 338
— surgical anatomy of - - - - - - 51
Aorta, coarctation of, associated with aneurysm - 365
Aortic body, chemodectoma of - - - - 585
— resection and grafting in coarctation of the aorta 365
Arterial clamps, effects of, on vessel wall - - 561
— disease, unsuspected - - - - - - 665
— segments in normal kidneys - - - - 605
— transplants, homologous, in arterial reconstruction - - - - - - - - - 450
Arteries, intrarenal, 'aberrant' and 'accessory' - 606
— — anatomy of - - - - - - - 605
— of jejunum, variations in blood-supply - - 473
— lower limb, pattern of occlusion in atheroma of - 352
— reconstruction of - - - - - - - 449
— — technique - - - - - - - 462
Arteriography of the normal kidney - - - 606
— in occlusion in atheroma of lower limb - - 352
— renal, at operation - - - - - - 615
Arteriovenous fistula as indication for arterial reconstruction - - - - - - - - 453
Artery, internal carotid, thrombosis of, following injury - - - - - - - - 215
— right subclavian, excision of aneurysm of - 94
Atheroma of lower limb arteries, occlusion in - - 352
— prognosis in - - - - - - - - 362
Atlanto-occipital method of vertebral angiography - 1

PAGE

BAMFORTH, J.: Early carcinomatous changes in the stomach - - - - - - - - 292
BARLOW, T. E.: Variations in the blood-supply of the upper jejunum - - - - - - 473
BARR, JAMES, and DAWS, ALEX: Obstruction of the superior longitudinal sinus by plasmocytoma 372
BARRETT, N. R.: Primary tumours of rib - - 113
BATY, JOHN A.: Traumatic rupture of hepatic duct 553
BICKFORD, B. J., EGAN, MARGARET, and BRYCE, A. GRAHAM: Surgical treatment of tumours of the heart. A report of two cases - - - 514
Bile-duct, blood-supply of, and relationship to duodenum - - - - - - - - 75
— cholangiography of - - - - - - 132
— recurrent and residual stones in - - - 198
BIRCH, DOREEN A., and JEPSON, R. P.: Micro-electrophoretic studies of plasma proteins in post-operative patients - - - - - 467
Bladder, urinary, of cat, repair of artificial ulcers in - 99
Blood-loss at operation, measurement of - - 191
Blood-supply of common bile-duct, and relationship to duodenum - - - - - - - 75
— upper jejunum, variations in - - - - 473
BOA, P. A.: Omental torsion as a surgical emergency 315
Bone, round-cell tumours of - - - - 380
BOWDEN, RUTH E. M.: The surgical anatomy of the recurrent laryngeal nerve - - - - 153
Brain-stem injury - - - - - - - - 595
BREARLEY, ROGER: Pilonidal sinus: a new theory of origin - - - - - - - - 62
Breast abscess, retromammary - - - - 330
BREWER, A. C., and JOHNSTON, J. H.: Myxoma of the mandible - - - - - - - - 325
BROCK, SIR RUSSELL, and WHYTEHEAD, L. L.: Radical pneumonectomy for bronchial carcinoma - - - - - - - - - 8
Bronchial carcinoma, pneumonectomy for - - 8
BRONKS, DORIS: *See* GILLMAN, THEODORE, jt. auth.
BROSSY, J.-J.: *See* GOLIGHER, J. C., jt. auth.
Brunner's gland, adenoma of - - - - 106
BRYCE, A. GRAHAM: *See* BICKFORD, B. J., jt. auth.
BURNETT, W., and WILLIAMS, A. WYNN: Intestinal pneumatosis associated with acute dilatation of the stomach - - - - - - - 68
Burns, failure of wound to contract in healing - 540
BUSSEY, H. J. R.: *See* LOCKHART-MUMMERY, H. E., jt. auth.

CALCULUS of kidney, segmental arteries in - 611
CANNEY, R. L.: Reticulosarcoma of the thyroid gland and stomach - - - 376
CAPPER, W. MELVILLE, and WELBOURN, RICHARD B.: Early post-cibal symptoms following gastrectomy. Aetiological factors, treatment and prevention - - - - - - 24
Carcinoma, bronchial, pneumonectomy for - - 8
— of colon, negative X-ray report in - - - 576
— gastric, gastric tuberculosis associated with - 573
— — metastasis to spermatic cord and intestinal tract 204
— islet-cell, giving rise to hyperinsulinism - - 580
— metastasizing, of the sweat-glands - - - 80
— of œsophagus, complicating achalasia of the cardia 413
— stomach, associated with chronic peptic ulcer - 292
— — early changes in - - - - - - 292
— third part of duodenum - - - - - 661
— thyroid, clinico-pathological study - - - 617
Cardiac tumours, surgical treatment of - - - 514
Cartilaginous tumours of rib - - - - 116
CHAUDHURI, M.: Large trichobezoar in childhood 441
Chemodectoma of an aortic body - - - 585

PAGE

Chest wall, tumours of - - - - - 113
Chlorpromazine, use of, in head injuries - - 595
Cholangiography of biliary and pancreatic ducts - 132
— in hepatic hydatid disease - - - - 308
Cholecystectomy, stones re-forming in bile-duct after 200
Cholelithiasis simulating pyloric neoplasm - - 105
Chondrosarcoma supervening on diaphysial aclasis 85
— with direct invasion of the myocardium - - 440
Circulation, collateral - - - - - - - 355
CLARKE, P. R. R., DICKSON, JUNE, and SMITH, B. J.: Traumatic thrombosis of the internal carotid artery following a non-penetrating injury and leading to infarction of the brain - - 215
CLINTON-THOMAS, C. L.: A giant leiomyoma of the kidney - - - - - - - - 497
CLYNE, A. J.: Post-traumatic pancreatic fistulæ: with a report of a case treated by jejunal implantation - - - - - - - - 180
Coarctation of the aorta associated with aneurysm - 365
COCKETT, F. B.: The pathology and treatment of venous ulcers of the leg - - - - - 260
Colectomy, total, and anterior resection of the rectum with ileorectal anastomosis - - - 297
— — with ileorectal anastomosis, in familial polyposis of colon - - - - - - 478
Colitis, ulcerative, colectomy and resection of the rectum with ileorectal anastomosis for - - 297
— — indications for surgical treatment - - 297
— — with dilatation of colon - - - - 182
Colon, cancer of, negative X-ray report in - - 576
— dilatation of, and ulcerative colitis - - - 182
— dog's, stomach-implanted, resistance to digestion 429
— fæcal contamination of, following gunshot injury 666
— familial polyposis of, surgical treatment - - 476
— gas gangrene of, in newborn infant - - - 659
— pelvic, spontaneous perforation of - - - 189
Compression of spinal cord by disk protrusion - 227
Condyle, external, of humerus, fractures of - - 88
Congenital abnormality as indication for arterial reconstruction - - - - - - - - 452
Conjoined twins - - - - - - - - - 626
Critical Review:—
The reconstruction of arteries - - - 449
CULLEN, T. H.: Solitary leiomyoma of skin - - 196
Cylindroma pattern of adenomatous tumours - 248
Cyst, enterogenous, of ileum - - - - - - 220
— of kidney, segmental arteries in - - - - 608
— lymphatic, of mesentery - - - - - - 304
— mesenteric, aetiology and pathology of - - 306
— squamous-cell, of thyroid - - - - - 565

DAVIDSON, JAMES S.: A case of congenital œsophageal diverticulum, lower accessory lobe and œsophagobronchial fistula - - 417
DAWS, ALEX: *See* BARR, JAMES, jt. auth.
Diaphragm, tumours of - - - - - - 633
Diaphragmatic hernia, strangulated - - - 289
DICKSON, JUNE: *See* CLARKE, P. R. R., jt. auth.
Digestion, resistance to, of stomach-implanted dog's colon - - - - - - - - - 429
Diverticulum, congenital œsophageal - - - 417
— Meckel's, fishbone perforation of - - - 555
— — perforation of, by pin - - - - 216
— — with mesenteric abscess - - - - 664
DOUGLAS, W. KEITH: Œsophageal strictures associated with gastroduodenal intubation - - 404
DUKES, CUTHBERT E.: *See* LOCKHART-MUMMERY, H. E., jt. auth.
DUNCAN, DAVID: Meckel's diverticulum with mesenteric abscess - - - - - - 664
Duodenum, carcinoma of third part of - - - 661
— relationship of blood-supply of common bile-duct to - - - - - - - - 75
Dysphasia, fibrous, of rib - - - - - - 122

EADIE, J. W.: Spontaneous perforation of the normal pelvic colon - - - - - - 189
EASTCOTT, H. H. G.: *See* ROB, C. G., jt. auth.
EGAN, MARGARET: *See* BICKFORD, B. J., jt. auth.
Electrolyte content of muscle samples obtained at surgical operations - - - - - - 71
— imbalance following ureterocolostomy - - 650
Electrophoresis, plasma proteins in post-operative patients measured by - - - - - 467
Embolectomy for arterial reconstruction - - 449
Embolus as indication for arterial reconstruction - 457
Epididymis, adenomatoid tumour of - - - 512
Epilepsy following missile head wounds - - 631
Epithelial regeneration in experimental wound healing - - - - - - - - 539, 544
Ewing's tumour, differential diagnosis of - - 380
Exostoses, multiple, of rib - - - - - - 116
Experimental Surgery:—
The inhibitory action of locally applied antihistamines on canine acid gastric secretion induced by histamine - - - - - 522
Prevention of the late complications of ureterocolostomy by methods of fæcal exclusion - 650
The repair of artificial ulcers in the urinary bladder of the cat - - - - - - 99
The resistance to digestion of the stomach-implanted dog's colon - - - - - 429
Studies in restorative growth processes in mammalian wound healing - - - 525

FÆCAL contamination of pleura following gunshot injury - - - - - - - - - 666
— exclusion to prevent late complications of ureterocolostomy - - - - - - 650
Femoral aneurysm, bilateral mycotic - - - 374
— thrombosis, secondary - - - - - - 353
Fistula, arteriovenous, as indication for arterial reconstruction - - - - - - - - 453
— left ureterocolonic, associated with abscess in left loin and fæcal fistula - - - - 646
— œsophagobronchial - - - - - - - 417
— pancreatic, post-traumatic - - - - 180
FLATT, ADRIAN E.: Chondrosarcoma supervening on diaphysial aclasis - - - - - 85
Flexor tendons in the hand, repair of - - - 35
Fluid-loss at operation, measurement of - - 191
Foregut, anterior, adenomatous tumours of - - 248
FORREST, A. P. M.: *See* KAY, A. W., jt. auth.
FORTY, FRANK: A carcinoma of the third part of the duodenum - - - - - - - 661
Fracture-dislocation of talus in childhood - - 600
Fractures of external condyle of humerus in children 88
FRASER, J. S.: Retromammary breast abscess - 330

GALL-BLADDER, papillomata of - - - 435
Ganglion in muscle belly of peroneus longus - 438
Gangrene, gas, of colon, in newborn infant - - 659
— of venous origin - - - - - - - 591
Gastrectomy, early post-cibal symptoms following - 24
— megaloblastic anæmia following - - - 422
— partial, small-bowel obstruction following - 104
Gastric carcinoma, early changes in - - - 292
— — metastasis to spermatic cord and intestinal tract - - - - - - - - 204
— mucosa, significance of, in œsophagus - - 409
— perforation following gastroscopy - - - 403
— secretion, canine, inhibitory action of antihistamines on - - - - - - - 522
Gastroduodenal intubation, œsophageal strictures associated with - - - - - - 404
Gastroscopy, complications of - - - - 396
GIBSON, R. MYLES: *See* LEWIN, WALPOLE, jt. auth.
GILLIS, D. A., REYNOLDS, D. P., and MERRITT, J. W.: Chemodectoma of an aortic body - 585
GILLMAN, THEODORE, PENN, JACK, BRONKS, DORIS, and ROUX, MARIE: A re-examination of certain aspects of the histogenesis of the healing of cutaneous wounds. - - - 141
Goitre, intrathoracic - - - - - - - 310
— — relation of laryngeal nerve vulnerability to, in thyroidectomy - - - - - - 174

PAGE

GOLDBERG, H. M., and HARVEY, PETER: Squamous-cell cysts of the thyroid. With special reference to the aetiology of squamous epithelium in the human thyroid - - 565
— and SMITH, VERNON H.: Acute volvulus of the stomach - - - - - - - - 588
GOLIGHER, J. C., LEACOCK, A. G., and BROSSY, J.-J.: The surgical anatomy of the anal canal 51
Grafting, free, technique of, in repair of tendons of hand - - - - - - - - 35
— and resection in coarctation of the aorta - - 365
Granulation tissue, growth of, in experimental wound healing - - - - - - - 528
Granuloma, lipoid, of rib - - - - - - - 125
— of neck following thorotrast angiography - - 638
GRATTAN, E.: Gunshot and sword wounds of thorax and abdomen - - - - - - 279
GRAVES, F. T.: A ganglion in the muscle belly of peroneus longus - - - - - - 438
— The anatomy of the intrarenal arteries in health and disease - - - - - - - 605
GRIFFITHS, EVAN: Papillomata of the gall-bladder - 435
GROGONO, B. J. S.: Neuroblastoma of the adrenal presenting with intraperitoneal hæmorrhage 550
GROVES, JOHN: Œsophageal carcinoma complicating achalasia of the cardia - - - - - 413
Growth processes, restorative, in experimental wound healing - - - - - - - 525
Gunshot injury, fæcal contamination of pleura following - - - - - - - - 666
— wounds of thorax and abdomen - - - 279

HÆMATOMA, chronic extradural - - - 599
Hæmorrhage, intraperitoneal, with neuroblastoma of the adrenal - - - - - 550
Hæmorrhoids, aetiology of - - - - - - 343
— operative procedure for - - - - - - 345
— results of operation for - - - - - - 349
— surgical treatment of - - - - - - 337
HAIGH, E.: Gas gangrene of the colon in a newborn infant. Report of a case successfully treated by total colectomy - - - - - - 659
Hand, repair of flexor tendons in - - - - - 35
HARVEY, PETER: *See* GOLDBERG, H. M., jt. auth.
Head injury, atypical, general therapeutic principles 595
— — following neck injury - - - - - 215
— wounds, missile - - - - - - - - 628
Heart, surgical treatment of tumours of - - - 514
HELMAN, PERCY, and KLIMAN, MURRAY: Paget's disease of the nipple. A clinical review of 27 cases - - - - - - - - - 481
HENLEY, F. AUSTIN: The blood-supply of the common bile-duct and its relationship to duodenum - - - - - - - - 75
HENSON, G. F.: A case of unsuspected arterial disease - - - - - - - - - 665
— and ROB, C. G.: A comparative study of the effects of different arterial clamps on the vessel wall - - - - - - - - 561
Hepatic duct, traumatic rupture of - - - - 553
Hernia, strangulated diaphragmatic - - - 289
— — inguinofemoral with descent of testis through femoral canal - - - - - 331
— ulcerated incisional, strangulation of - - 329
Histamine-induced gastric secretion in dogs, inhibitory action of antihistamine on - - - 522
HOFFMAN, E.: Intrathoracic goitre - - - 310
HOLDSWORTH, W. G., and ROWE, N. L.: Adamantinoma. A brief review of the condition, with a description of a case treated by immediate replacement with a tantalum and acrylic prosthesis following resection of the affected area of the mandible - - - - - - 255
HOLGATE, JOHN, and IKPEME, B. J.: Conjoined twins 626
HORLEY, J. F.: Chondrosarcoma with direct invasion of the myocardium. Report of a case 440
HUGHES, E. S. R.: Recurrent and residual stones in the common bile-duct - - - - - 198

PAGE

Humerus, fractures of external condyle of, in children - - - - - - - - - 88
Hunterian Lectures:—
The anatomy of the intrarenal arteries in health and disease - - - - - - - - 605
Primary tumours of rib - - - - - 113
Hydatid disease, hepatic, cholangiography in - - 308
Hyperchloræmic acidosis following ureterocolic anastomosis - - - - - - - - 650
Hyperthyroidism, occurrence in thyroid cancer - 620
Hypoglycæmia, metastasizing insulinoma with - 579
Hypothermia as an aid to surgery - - - - - 569
— induced, in head injuries - - - - - 595
— methods of - - - - - - - - 570
— physiological observations - - - - 572
— technique of - - - - - - - - 571

IKPEME, B. J.: *See* HOLGATE, JOHN, jt. auth.
Ileorectal anastomosis, with total colectomy and resection of rectum - - - - - - 297
Ileum, enterogenous cyst of - - - - - - 220
In Memoriam:—
Sir D'Arcy Power - - - - - - 324
Infection, inhibition of wound to contract in healing 540
Injury, arterial, as indication for arterial reconstruction - - - - - - - - - 453
Insulinoma metastasizing, with hypoglycæmia - 579
Interdigital sinus in barber's hand - - - 520
Intervertebral disk protrusions involving spinal cord 225
Intestine, ileal cyst of - - - - - - - 220
— intussusception of - - - - - - - 207
— metastasis of gastric carcinoma to - - - 204
Intrathoracic goitre - - - - - - - 310
Intussusception, retrograde - - - - - - 207
IRVINE, W. T., ALLAN, C., and WEBSTER, D. R.: Prevention of the late complications of ureterocolostomy by methods of fæcal exclusion - - - - - - - - 650
Ischæmia, unsuspected, masked by orthopædic lesion 665

JAW, tumour of - - - - - - - - - 325
Jejunum, blood-supply of, variations in - - 473
— implantation of, for post-traumatic pancreatic fistula - - - - - - - - - 180
JEPSON, R. P., JORDAN, A., and LEVELL, M. J.: Urinary steroid response to operation - - 390
— *See* BIRCH, DOREEN A., jt. auth.
JOHN, E. LEIGHTON: Perforation of Meckel's diverticulum by a pin - - - - - 216
JOHNSON, F. R.: *See* MCMINN, R. M. H., jt. auth.
JOHNSTON, J. H.: *See* BREWER, A. C., jt. auth.
JORDAN, A.: *See* JEPSON, R. P., jt. auth.

KATZ, GERSON: A case of fæcal contamination of the pleura and gastrocolic communication following gunshot injury - - - - - 666
KAY, A. W., and FORREST, A. P. M.: The inhibitory action of locally applied antihistamines on canine acid gastric secretion induced by histamine - - - - - - - - 522
KENNEDY, J. D.: *See* MACDERMOTT, E. N., jt. auth.
Ketogenic steroid response to surgery - - - 390
Kidney, anatomy of arteries of - - - - 605
— giant leiomyoma of - - - - - - 497
KLIMAN, MURRAY: *See* HELMAN, PERCY, jt. auth.
Korea, missile head wounds during campaign in - 628

LARYNGEAL nerve, recurrent, surgical anatomy of 153
— — — vulnerability at thyroidectomy - 164
LEACOCK, A. G.: *See* GOLIGHER, J. C., jt. auth.
Leg, anatomy and physiology of venous system of - 263
— ulcers, venography in - - - - - - 269
— venous ulcers of, pathology and treatment - 260
— — — surgical treatment of - - - - 272
Leiomyoma, giant, of kidney - - - - - 497
— solitary, of skin - - - - - - - 196
Lesion of spinal cord from disk protrusion - - 225
LEVELL, M. J.: *See* JEPSON, R. P., jt. auth.

PAGE

LEVY, LAURENCE F.: Granuloma of the neck following thorotrast angiography - - 638
LEWIN, WALPOLE, and GIBSON, R. MYLES: Missile head wounds in the Korean campaign. A survey of British casualties - - - 628
Liver, cholangiography in hydatid disease - - 308
LOCKHART-MUMMERY, H. F., DUKES, CUTHBERT E., and BUSSEY, H. J. R.: The surgical treatment of familial polyposis of the colon - 476
LUMB, GEORGE, and MACKENZIE, D. H.: Round-cell tumours of bone - - - - - - 380
— PROTHEROE, ROGER H. B., and RAMSAY, GORDON S.: Ulcerative colitis with dilatation of the colon - - - - - - - - 182
Lung, lower accessory lobe of - - - - - 417
— supernumerary - - - - - - - 327
Lymphatic cysts of mesentery - - - - 304

MACAULAY, DUNCAN, and MOORE, THOMAS: Enterogenous cyst of the ileum - - - 220
MACDERMOTT, E. N., and KENNEDY, J. D.: A case of melanoblastoma of the penis - - - 213
MACINTYRE, HUGH W.: Adenomatoid tumour of epididymis - - - - - - - - 512
MACIVER, I. N., SMITH, B. J., TOMLINSON, B. E., and WHITBY, J. D.: Rupture of the œsophagus associated with lesions of the central nervous system - - - - - - - 505
MACKENZIE, D. H.: *See* LUMB, GEORGE, jt. auth.
MCMINN, R. M. H., and JOHNSON, F. R.: The repair of artificial ulcers in the urinary bladder of the cat - - - - - - 99
Malignant disease as indication for arterial reconstruction - - - - - - - - 457
Mammalian wound healing, experimental, growth processes in - - - - - - - - 525
Mandible, myxoma of - - - - - - - 325
— resection of, in adamantinoma - - - 255
MASLOWSKI, HENRY A.: Vertebral angiography: percutaneous lateral atlanto-occipital method 1
MATHESON, A. TOM: Perforated peptic ulcer: the immediate and long-term sequelæ - - 641
MAVOR, G. E.: The pattern of occlusion in atheroma of the lower limb arteries. The correlation of clinical and arteriographic findings 352
Meckel's diverticulum, fishbone perforation of - 555
— — perforation of, by pin - - - - - 216
— — with mesenteric abscess - - - - - 664
Megaloblastic anæmia following gastric resection - 422
Melanoblastoma of penis - - - - - - 213
Meningocele, anterior sacral - - - - - 301
MERRITT, J. W.: *See* GILLIS, D. A., jt. auth.
Mesentery, abscess of, with Meckel's diverticulum - 664
— lymphatic cysts of - - - - - - - 304
Metastases in sweat-gland carcinoma - - - 80
MOFFAT, F., and ANDERSON, W.: Adenoma of Brunner's gland - - - - - - 106
MOLONEY, G. E.: Excision of an aneurysm of the right subclavian artery. Case history and discussion - - - - - - - 94
MOORE, R. F., and SCOTT, G. B. D.: Gangrene of venous origin - - - - - - - - 591
MOORE, THOMAS: *See* MACAULAY, DUNCAN, jt. auth.
Morphine, biliary side-effects of, in cholangiography 136
Muscle samples, electrolyte content of, at surgical operations - - - - - - - - 71
Mycotic aneurysm, bilateral femoral - - - 374
Myeloma of rib - - - - - - - - 126
Myelomatosis, multiple, with obstruction of the superior longitudinal sinus - - - - 372
Myocardium, direct invasion of with chondrosarcoma - - - - - - - - 440
Myxoma of the mandible - - - - - - 325

NECK, non-penetrating injury to, causing thrombosis - - - - - - - - - 215
NELSON, M. G.: *See* WELBOURN, R. B., jt. auth.
Neoplasm, pyloric, cholelithiasis simulating - - 105
Nerves, laryngeal, damage to, in thyroidectomy - 169
— recurrent laryngeal, surgical anatomy of - - 153
— — — vulnerability at thyroidectomy - - 164
Nervous system, central, lesions of, associated with œsophageal rupture - - - - - - 505
Neuroblastoma of the adrenal with intraperitoneal hæmorrhage - - - - - - - 550
— differential diagnosis of - - - - - 381
Neurological disability following missile head wounds 631
Neurosurgery for missile wounds in Korean campaign - - - - - - - - 628
NICHOLSON, FRANK, and WHITEHEAD, RAYMOND: Tumours of the diaphragm - - - - 633
Nipple, Paget's disease of - - - - - - 481

OCCLUSION, pattern of, in atheroma of lower limb arteries - - - - - - - - 352
O'CONNELL, JOHN E. A.: Involvement of the spinal cord by intervertebral disk protrusions - 225
O'DONOGHUE, P. D.: Strangulation of an ulcerated incisional hernia - - - - - - 329
Œsophageal diverticulum, congenital - - - 417
Œsophagitis, gastric mucous membrane with - 409
Œsophagobronchial fistula - - - - - - 417
Œsophagoscopy, complications of - - - 396
Œsophagus, carcinoma of, complicating achalasia of the cardia - - - - - - - - 413
— lower, injury to, following endoscopy - - 403
— rupture of, associated with lesions of central nervous system - - - - - - - 505
— significance of gastric mucosa in - - - 409
— strictures of, with gastroduodenal intubation - 404
— upper, injury to, following endoscopy - - 397
Omental torsion - - - - - - - - 315
Osteochondroma of rib - - - - - - - 114
Osteoclastoma of rib - - - - - - - 127
Osteomata of the paranasal sinuses - - - 489
Osteomyelitis of mandible following gastroscopy - 397
OWEN, K.: *See* ROB, C. G., jt. auth.

PAGET'S disease of the nipple - - - - 481
Pancreatic ducts, radiography of - - - 132
— fistulæ, post-traumatic - - - - - - 180
Papillomata of gall-bladder - - - - - - 435
PAPP, CORNELIO: *See* SELLORS, T. HOLMES, jt. auth.
PARKS, A. G.: The surgical treatment of hæmorrhoids - - - - - - - - - 337
Parotitis, chronic 'sialectatic'; pathological studies 43
PATEY, DAVID H., and THACKRAY, A. C.: Chronic 'sialectatic' parotitis in the light of pathological studies on parotidectomy material - 43
Penis, melanoblastoma of - - - - - - 213
PENN, JACK: *See* GILLMAN, THEODORE, jt. auth.
Peptic ulcer, perforated: immediate and long-term sequelæ - - - - - - - - 641
Perforation of normal pelvic colon - - - 189
Peroneus longus, ganglion in muscle belly of - - 438
Physiology of venous system of leg - - - 263
Pilonidal sinus - - - - - - - - 62
Plasma proteins in post-operative patients, micro-electrophoretic studies of - - - - 467
Plasmocytoma, obstruction of superior longitudinal sinus by - - - - - - - - 372
Pleura, fæcal contamination of, following gunshot injury - - - - - - - - 666
Pneumatosis, intestinal, associated with acute dilatation of the stomach - - - - - - 68
Pneumonectomy, radical, for bronchial carcinoma - 8
Polyposis, familial, of colon, surgical treatment of - 476
Popliteal thrombosis, secondary - - - - 355
POWELL, H. D. W.: Interdigital sinuses in barber's hand - - - - - - - - 520
PROBERT, W. R.: Cholangiography in hepatic hydatid disease - - - - - - - 308
Prostheses, artificial, materials used, in arterial reconstruction - - - - - - - 451
PROTHEROE, ROGER, H. B.: *See* LUMB, GEORGE, jt. auth.

PAGE

Pulmonary mass, ectopic - - - - - - 327
Pylorus, cholelithiasis simulating neoplasm of - 105

RADIOGRAPHY of biliary and pancreatic ducts - 132
— in cancer of the colon - - - - - 576
RAINS, ANTHONY J. H.: Experience in the measurement of blood- and fluid-loss at operation - 191
RAMSAY, GORDON S.: The negative X-ray report in cancer of the colon - - - - - - 576
— *See* LUMB, GEORGE, jt. auth.
Rare Cases:—
Adenoma of Brunner's gland - - - - - 106
A carcinoma of the third part of the duodenum 661
A case of fæcal contamination of the pleura and gastrocolic communication following gunshot injury - - - - - - - - - 666
A case of unsuspected arterial disease - - 665
Cholelithiasis simulating pyloric neoplasm - 105
Chondrosarcoma with direct invasion of the myocardium - - - - - - - - 440
Enterogenous cyst of the ileum - - - - 220
Fishbone perforation of Meckel's diverticulum 555
A ganglion in the muscle belly of peroneus longus - - - - - - - - - 438
Gas gangrene of the colon in a newborn infant. Report of a case successfully treated by total colectomy - - - - - - - - - 659
Large trichobezoar in childhood - - - - 441
Meckel's diverticulum with mesenteric abscess 664
Myxoma of the mandible - - - - - 325
Neuroblastoma of the adrenal presenting with intraperitoneal hæmorrhage - - - - 550
Papillomata of the gall-bladder - - - - 435
Perforation of Meckel's diverticulum by a pin - 216
Retromammary breast abscess - - - - 330
Small bowel obstruction following partial gastrectomy - - - - - - - - 104
Strangulated inguinofemoral hernia with descent of the testis through the femoral canal 331
Strangulation of an ulcerated incisional hernia - 329
A supernumerary lung - - - - - - 327
Thyroid abscess - - - - - - - - 218
Traumatic rupture of hepatic duct - - - - 553
Traumatic thrombosis of the internal carotid artery following a non-penetrating injury and leading to infarction of the brain - - - 215
RATLIFF, A. H. C.: Tuberculosis at the site of spondylolisthesis - - - - - - - 502
RAVEN, RONALD W.: Total colectomy and anterior resection of the rectum with ileorectal anastomosis. A one-stage operation for ulcerative colitis - - - - - - - - - 297
RAWLINSON, J. K. M.: Fishbone perforation of Meckel's diverticulum - - - - - 555
Reconstruction of arteries - - - - - - 449
REECE, M. W.: Thyroid abscess - - - - 218
Renal damage following ureterocolostomy - - 650
— tumour, giant - - - - - - - - 497
Resection of rectum and total colectomy with ileorectal anastomosis - - - - - - - 297
Reticulosarcoma of the thyroid gland and stomach - 376
Reticulum-cell sarcoma, differential diagnosis of - 380
Reviews (Titles):—
The abdominal pneumoencephalogram (L. M. Davidoff and B. S. Epstein) - - - 110
Advanced surgery of cataract (D. Kirby) - - 111
Advances in pediatrics, Vol. III (ed. S. Z. Levine) - - - - - - - - - 671
Alfred hospital: clinical reports, 1955 (ed. R. S. Lawson) - - - - - - - - 670
Analgesia for midwives (Hilda Roberts) - - 560
L'anesthésie en chirurgie thoracique (O. Monod and others) - - - - - - - - 557
Antibiotics annual, 1954–55 (ed. H. Welch and F. Marti-Ibañez) - - - - - - 222
Arthroplasty (St. J. D. Buxton) - - - - 559
An atlas of musculoskeletal exposures (H. F. Moseley) - - - - - - - - - 109

PAGE

Reviews (Titles), *continued.*
Atlas of roentgen anatomy of the skull (L. E. Etter) - - - - - - - - - 223
Babcock's principles and practice of surgery (K. C. Jonas) - - - - - - - - - 109
The back and its disk syndromes (P. Lewin) - 558
Basic surgical skills (R. Tauber) - - - - 671
Bickham-Callender's surgery of the alimentary tract (R. T. Shackelford, asstd. by H. J. Dugan) - - - - - - - - - 109
Blood supply and anatomy of the upper abdominal organs (N. A. Michels) - - - - - 560
Body fluids in surgery (A. W. Wilkinson) - - 445
Bone (F. C. McLean and M. R. Urist) - - 107
Bone and bones: fundamentals of bone biology (J. P. Weinmann and H. Sicher) - - - 224
Breast cancer (E. F. Lewison) - - - - 333
The British encyclopædia of medical practice. Medical progress 1955 (ed. Lord Horder) - 333
British Medical Bulletin, Vol. II. *Surgery of the heart and thoracic blood vessels* (ed. N. R. Barrett) - - - - - - - - - 332
Le cancer du plancher de la bouche (M. Dargent and J. Papillon, with J. F. Montbarbon) - 669
Cardiac anomalies (V. Moragnes and C. P. Lynxwiler) - - - - - - - - 333
Cardiovascular surgery (ed. C. R. Lam) - - 445
Chest X-ray diagnosis (M. Ritvo) - - - - 671
Chirurgie des glandes salivaires (H. Redon) - 669
Christopher's minor surgery (ed. A. Ochsner and M. E. DeBakey) - - - - - - - 334
Christopher's textbook of surgery (ed. L. Davis) - 559
Clinical neurosurgery. Proceedings of the congress of neurological surgeons, New Orleans - - 222
Clinical neurosurgery. Proceedings of the congress of neurological surgeons, New York - - 670
The diagnosis and treatment of hæmophilia and its related conditions ((R. G. Macfarlane and Rosemary Biggs) - - - - - - - 334
Diseases of the nose and throat (Sir St. Clair Thomson, rev. V. E. Negus, asstd. by G. H. Bateman) - - - - - - - - - 446
Ear, nose, and throat nursing (F. Boyes Korkis) - 445
Early care of acute soft tissue injuries (American College of Surgeons) - - - - - - 107
Essentials of orthopædics (P. Wiles) - - - 110
Fluid and electrolytes in practice (H. Statland) - 108
Fractures in children (W. P. Blount) - - - 110
Fractures of the facial skeleton (N. L. Rowe and H. C. Killey) - - - - - - - - 446
Fractures and joint injuries. Vol. II. (Sir Reginald Watson-Jones) - - - - - 107
The genesis and prevention of cancer (W. Sampson Handley) - - - - - - - 110
A handbook of modern operative surgery (K. Das) 558
Hernia (C. B. McVay) - - - - - - 108
Intestinal obstructions (O. H. Wangensteen) - 223
Introduction to hepatic surgery (H. Gane) - - 335
Keratoplasty (R. Townley Paton) - - - 558
Leg ulcers: their causes and treatment (S. T. Anning) - - - - - - - - - 223
Living bone in health and disease (I. Stein, R. O. Stein, and M. L. Beller) - - - - - 447
Local analgesia: head and neck (Sir Robert Macintosh and Mary Ostlere) - - - - 446
The Lung (J. H. Comroe, R. E. Forster, A. B. Dubois, W. H. Briscoe, and Elizabeth Carlsen) 111
Management of pain in cancer (ed. M. J. Schiffrin) - - - - - - - - - 670
Manual of hand injuries (H. M. Nichols) - - 668
A manual of practical obstetrics (O'Donel Browne) (ed. J. G. Gallagher) - - - 671
The mechanisms of healing in human wounds (S. W. Hartwell) - - - - - - 334
Medical photography (T. A. Longmore) - - 447
Modern operative surgery (ed. G. Grey Turner and L. C. Rogers) - - - - - - 332
Modern trends in orthopædics (ed. Sir Harry Platt) 668

PAGE

Reviews (Titles), *continued.*

Mysterious waters to guard. Essays and addresses on anæsthesia (W. Bourne) - - - - 110
Neurovascular hila of limb muscles (J. C. Brash) - 111
New concepts of surgery of vascular system (E. Holman) - - - - - - - - - 557
Obstetrics (J. P. Greenhill) - - - - - 559
Outline of orthopædics (J. C. Adams) - - - 668
An outline of the treatment of fractures (American College of Surgeons) - - - - - - 107
Pain (J. C. White and W. H. Sweet, asstd. by S. Cobb and Frances J. Bonner) - - 108
Pathology for the surgeon (W. Boyd) - - 112
Peptic ulcer (C. J. Barborka and E. C. Texter) - 558
The principles and practice of surgical nursing (D. F. Ellison Nash) - - - - - - 108
Proctologic anatomy (R. V. Gorsch) - - 559
Professional negligence (J. P. Eddy) - - - 109
Roentgen interpretation (G. W. Holmes and L. L. Robbins) - - - - - - 669
Salivary gland tumours (D. E. Ross) - - 332
Segmental anatomy of the lungs (E. A. Boyden) - 108
The Sherrington Lectures. III. *The Invasive adenomas of the anterior pituitary* (Sir Geoffrey Jefferson) - - - - - - 107
A short textbook of surgery (C. F. W. Illingworth) 335
The spine (B. S. Epstein) - - - - - 334
Standard atlas of human anatomy. Vol. I. (M. W. Woerdeman) - - - - - - 558
Subphrenic abscess (H. R. S. Harley) - - 446
Suprapubic prostatectomy (T. Huyrtschak; trans. N. S. R. Maluf) - - - - - 332
Surgery of the ambulatory patient (L. K. Ferguson) - - - - - - - 670
Surgery for nurses (J. Moroney) - - - 223
Surgery of the small and large intestine (C. W. Mayo) - - - - - - - - - 111
Surgery of the stomach and duodenum (C. E. Welch) - - - - - - - - - 335
Surgery of the sympathetic (A. L. McGregor) - 111
The surgery of Theodoric (trans. E. Campbell and J. Colton) - - - - - - - 447
Surgical forum. Clinical congress of the American College of Surgeons 1954. Vol. V - - - 112
Surgical physiology of the adrenal cortex (J. D. Hardy) - - - - - - - - - 224
The surgical technic of abdominal operations (J. L. Spirack) - - - - - - - 558
Textbook of orthopædic medicine (J. Cyriax) - 445
Textbook of surgery (ed. H. F. Moseley) - - 335
Thomas Fairbank birthday volume (*Journal of Bone and Joint Surgery*) - - - - - 671
Thoracic surgical management (J. R. Belcher and I. W. B. Grant) - - - - - 333
Transactions of the American College of Cardiology. Vol. III - - - - - - 107
Transplantation of tissues (L. A. Peer) - - 335
The year book of general surgery 1955–56 (ed. E. A. Graham, S. C. Cullen) - - - 447
The year book of neurology, psychiatry, and neurosurgery (ed. R. P. Mackay, S. B. Wortis, P. Bailey, and O. Sugar) - - - - - 109
The year book of urology, 1954–55 (ed. W. W. Scott) - - - - - - - - - 222

Reviews (Authors):—

Adams, J. C.: *Outline of orthopædics* - - 668
Anning, S. T.: *Leg ulcers: their causes and treatment* - - - - - - - - 223
Bailey, P.: *See* Mackay, R. P., jt. ed.
Barborka, C. J., and Texter, E. C.: *Peptic ulcer* - - - - - - - - - 558
Barrett, N. R.: *British Medical Bulletin: Surgery of the heart and thoracic blood vessels* (ed.) - - - - - - - - - 332
Bateman, G. H.: *See* Thomson, Sir St. Clair
Belcher, J. R., and Grant, I. W. B.: *Thoracic surgical management* - - - - - - 333
Beller, M. L.: *See* Stein, I., jt. auth.

PAGE

Reviews (Authors), *continued.*

Biggs, Rosemary: *See* Macfarlane, R. G., jt. auth.
Blount, W. P.: *Fractures in children* - - 110
Bonner, Frances J.: *See* White, J. C.
Bourne, W.: *Mysterious waters to guard. Essays and addresses on anæsthesia* - - - - 110
Boyd, W.: *Pathology for the surgeon* - - 112
Boyden, E. A.: *Segmental anatomy of the lungs* 108
Brash, J. C.: *Neurovascular hila of limb muscles* 111, 223
Briscoe, W. A.: *See* Comroe, J. H., jt. auth.
Browne, O'Donel: *A manual of practical obstetrics* (ed. J. G. Gallagher) - - - 671
Buxton, St. J. D.: *Arthroplasty* - - - 559
Campbell, E., and Colton, J.: *The surgery of Theodoric* (trans.) - - - - - - 447
Carlsen, Elizabeth: *See* Comroe, J. H., jt. auth.
Cobb, S.: *See* White, J. C.
Colton, J.: *See* Campbell, E., jt. trans.
Comroe, J. H., Forster, R. E., Dubois, A. B., Briscoe, W. A., and Carlsen, Elizabeth: *The Lung* - - - - - - - - - - 111
Cullen, S. C.: *See* Graham, E. A., part ed.
Cyriax, J.: *Textbook of orthopædic medicine.* Vol. I - - - - - - - - - 445
Dargent, M., and Papillon, J.: *Le cancer du plancher de la bouche* - - - - - - 669
Das, K.: *A handbook of modern operative surgery* - - - - - - - - - 558
Davidoff, L. M., and Epstein, B. S.: *The abnormal pneumoencephalogram* - - - 110
Davis, L.: *Christopher's textbook of surgery* (ed.) 559
DeBakey, M. E.: *See* Ochsner, A., jt. ed.
Dubois, A. B.: *See* Comroe, J. H., jt. auth.
Dugan, H. J.: *See* Shackelford, R. T.
Eddy, J. P.: *Professional negligence* - - 109
Epstein, B. S.: *See* Davidoff, L. M., jt. auth.
— — *The Spine* - - - - - - - - 333
Etter, L. E.: *Atlas of roentgen anatomy of the skull* 223
Ferguson, L. K.: *Surgery of the ambulatory patient* - - - - - - - - - 670
Forster, R. E.: *See* Comroe, J. H., jt. auth.
Gallagher, J. G.: *A manual of practical obstetrics* (O'Donel Browne) (ed.) - - - - - 671
Gane, H.: *Introduction to hepatic surgery* - 335
Gorsch, R. V.: *Proctologic anatomy* - - 559
Graham, E. A., and Cullen, S. C.: *The year book of general surgery*, 1955–1956 (ed.) - 447
Grant, I. W. B.: *See* Belcher, J. R., jt. auth.
Greenhill, J. P.: *Obstetrics* - - - - - 559
Handley, W. S.: *The genesis and prevention of cancer* - - - - - - - - - 110
Hardy, J. D.: *Surgical physiology of the adrenal cortex* - - - - - - - - - 224
Harley, H. R. S.: *Subphrenic abscess* - - 446
Hartwell, S. W.: *The mechanisms of healing in human wounds* - - - - - - - - 334
Holman, E.: *New concepts of surgery of the vascular system* - - - - - - - - 557
Holmes, G. W., and Robbins, L. L.: *Roentgen interpretation* - - - - - - - - 669
Horder, Lord: *The British encyclopædia of medical practice. Medical progress* 1955 (ed.) 333
Huyrtschak, T.: *Suprapubic prostatectomy* - 332
Illingworth, C. F. W.: *A short textbook of surgery* - - - - - - - - - 335
Jefferson, Sir Geoffrey: *The Sherrington lectures.* III. *The invasive adenomas of the anterior pituitary* - - - - - - 107
Jonas, K. C.: *Babcock's principles and practice of surgery* (ed.) - - - - - - - 109
Killey, H. C.: *See* Rowe, N. L., jt. auth.
Kirby, D.: *Advanced surgery of cataract* - 111
Korkis, F. B.: *Ear, nose, and throat nursing* - 445
Lam, C. R.: *Cardiovascular surgery* (ed.) - 445
Lawson, R. S.: *Alfred hospital: clinical reports*, 1955 (ed.) - - - - - - - - 670

Reviews (Authors), *continued.* PAGE

Levine, S. Z.: *Advances in pediatrics.* Vol. VIII (ed.) - - - - - - - - 671
Lewin, P.: *The back and its disk syndromes* - 558
Lewison, E. F.: *Breast cancer* - - - - 333
Longmore, T. A.: *Medical photography* - - 447
Lynxwiler, C. P.: *See* Moragnes, V., jt. auth.
Macfarlane, R. G., and Biggs, Rosemary: *The diagnosis and treatment of hæmophilia and its related conditions* - - - - - - 334
McGregor, A. L.: *Surgery of the sympathetic* - 111
Macintosh, Sir Robert, and Ostlere, Mary: *Local analgesia: head and neck* - - - - 446
Mackay, R. P., Wortis, S. B., Bailey, P., and Sugar, O.: *The year book of neurology, psychiatry, and neurosurgery* (ed.) - - 109
McLean, F. C., and Urist, M. R.: *Bone* - 107
McVay, C. B.: *Hernia* - - - - - - - 108
Maluf, N. S. R.: *Suprapubic prostatectomy* (Huyrtschak) (trans.) - - - - - 332
Marti-Ibañez, F.: *See* Welch, H., jt. ed.
Mayo, C. W.: *Surgery of the small and large intestine* - - - - - - - - - 111
Michels, N. A.: *Blood supply and anatomy of the upper abdominal organs* - - - - - 560
Monod, O., and others: *L'anesthésie en chirurgie thoracique* - - - - - - - - - 557
Montbarbon, J.-F.: *See* Dargent, M.
Moragnes, V., and Lynxwiler, C. P.: *Cardiac anomalies* - - - - - - - - - 333
Moroney, J.: *Surgery for nurses* - - - - 223
Moseley, H. F.: *An atlas of musculoskeletal exposures* - - - - - - - - - 109
— *Textbook of surgery* (ed.) - - - - - 335
Nash, D. F. Ellison: *The principles and practice of surgical nursing* - - - - - - 108
Negus, V. E.: *See* Thomson, Sir St. Clair (rev.)
Nichols, H. M.: *Manual of hand injuries* - 668
Ochsner, A., and DeBakey, M. E.: *Christopher's minor surgery* (ed.) - - - - - - 334
Ostlere, Mary: *See* Macintosh, Sir Robert, jt. auth.
Papillon, J.: *See* Dargent, M., jt. auth.
Paton, R. T.: *Keratoplasty* - - - - - 558
Peer, L. A.: *Transplantation of tissues* - - 335
Platt, Sir Harry: *Modern trends in orthopædics* (ed.) - - - - - - - - - - 668
Redon, H.: *Chirurgie des glandes salivaires* - 669
Ritvo, M.: *Chest X-ray diagnosis* - - - 671
Robbins, L. L.: *See* Holmes, G. W., jt. auth.
Roberts, Hilda: *Analgesia for midwives* - - 560
Rogers, L. C.: *See* Turner, G. Grey, jt. ed.
Ross, D. E.: *Salivary gland tumours* - - 339
Rowe, N. L., and Killey, H. C.: *Fractures of the facial skeleton* - - - - - - 446
Schiffrin, M. J.: *Management of pain in cancer* (ed.) - - - - - - - - - - 670
Scott, W. W.: *The year book of urology, 1954–1955* (ed.) - - - - - - - - - 222
Shackelford, R. T.: *Bickham-Callender's surgery of the alimentary tract* - - - - - 109
Sicher, H.: *See* Weinmann, J. P., jt. auth.
Spirack, J. L.: *The surgical technic of abdominal operations* - - - - - - - - - 558
Statland, H.: *Fluid and electrolytes in practice* 108
Stein, I., Stein, R. O., and Beller, M. L.: *Living bone in health and disease* - - - 447
Stein, R. O.: *See* Stein, I., jt. auth.
Sugar, O.: *See* Mackay, R. P., jt. ed.
Tauber, R.: *Basic surgical skills* - - - 671
Texter, E. C.: *See* Barborka, C. J., jt. auth.
Thomson, Sir St. Clair, and Negus, V. E.: *Diseases of the nose and throat* (rev.) - - 446
Turner, G. Grey, and Rogers, L. C.: *Modern operative surgery* (ed.) - - - - - 332
Urist, M. R.: *See* McLean, F. C., jt. auth.
Wangensteen, O. H.: *Intestinal obstructions* - 223

Reviews (Authors), *continued.* PAGE

Watson-Jones, Sir Reginald: *Fractures and joint injuries* - - - - - - - - 107
Weinemann, J. P.: *Bone and bones: fundamentals of bone biology* - - - - - 224
Welch, C. E.: *Surgery of the stomach and duodenum* - - - - - - - - - 335
Welch, H.: *Antibiotics annual, 1954–1955* (ed.) 222
White, J. C., and Sweet, W. H.: *Pain* - - 108
Wiles, P.: *Essentials of orthopædics* - - 110
Wilkinson, A. W.: *Body fluids in surgery* - 445
Woerdeman, M. W.: *Standard atlas of human anatomy.* Vol. I - - - - - - - 558
Wortis, S. B.: *See* Mackay, R. P., jt. ed.
Reynolds, D. P.: *See* Ellis, D. A., jt. auth.
Rib, cartilaginous tumours of - - - - - 116
— fibrous dysplasia of - - - - - - - 122
— lipoid granuloma of - - - - - - - 125
— multiple exostoses of - - - - - - - 116
— myeloma of - - - - - - - - - 126
— osteochondroma of - - - - - - - - 114
— osteoclastoma of - - - - - - - - 127
— primary tumours of - - - - - - - 113
Rob, C. G., Eastcott, H. H. G., and Owen, K.: The reconstruction of arteries - - - 449
— — *See* Henson, G. F., jt. auth.
Rogers, Lambert: Bilateral mycotic femoral aneurysms. Report of a case with some remarks on mycotic aneurysms in general - 374
Ross, D. N.: Hypothermia as an aid to surgery - 569
Roux, Marie: *See* Gillman, Theodore, jt. auth.
Rowe, N. L.: *See* Holdsworth, W. G., jt. auth.
Rowlands, B. C.: Anterior sacral meningocele. Report of two cases - - - - - - - 301
Rupture, traumatic of hepatic duct - - - 553
Russell, Helen: Adenomatous tumours of the anterior foregut region showing the cylindroma pattern - - - - - - - - 248

Schofield, Graham E.: A supernumerary lung - - - - - - - - - - 327
Scott, Foster: *See* Alhadeff, Robert, jt. auth.
Scott, G. B. D.: *See* Moore, R. F., jt. auth.
Sedzimir, C. B.: Atypical head injuries illustrating general therapeutic principles - - - 595
Sellors, T. Holmes: Coarctation of the aorta associated with aneurysm - - - - - 365
— — and Papp, Cornelio: Strangulated diaphragmatic hernia with torsion of the stomach - 289
Sex incidence in intervertebral disk protrusions - 238
Shaw, R. Cunliffe: Metastasizing insulinoma with hypoglycæmia - - - - - - - - 579
Sinus, interdigital, in barber's hand - - - 520
— longitudinal, superior, obstruction by plasmocytoma - - - - - - - - - 372
— paranasal, osteomata of - - - - - - 489
— pilonidal - - - - - - - - - 62
Sircus, W.: The resistance to digestion of the stomach-implanted dog's colon - - - 429
Skull, impalement of - - - - - - - - 597
Small-bowel obstruction following gastrectomy - 104
Smith, B. J.: *See* Clarke, P. R. R., jt. auth.
— *See* Maciver, I. N., jt. auth.
Smith, Carey C. K.: Metastasizing carcinoma of the sweat-glands - - - - - - - - 80
— — and Tanner, Norman C.: The complications of gastroscopy and œsophagoscopy - 396
Smith, Vernon H.: *See* Goldberg, H. M., jt. auth.
Spermatic cord, metastasis of gastric carcinoma to - 204
Spinal cord, involvement of, by intervertebral disk protrusions - - - - - - - - 225
Spleen, ruptured - - - - - - - - 283
Splenectomy, treatment of choice in ruptured spleen 287
Spondylolisthesis, tuberculosis at site of - - 502
Squamous epithelium in the human thyroid - - 565
Standeven, A.: Small-bowel obstruction following partial gastrectomy - - - - - - 104

PAGE

STEPHENS, N. A.: Fracture-dislocation of the talus in childhood. A report of two cases - - 600
STIRK, D. I.: Strangulated inguinofemoral hernia with descent of the testis through the femoral canal. A report of one case and review of the literature - - - - - - - 331
Stomach, acute volvulus of - - - - - 588
— association of gastric tuberculosis and carcinoma 573
— carcinoma of, associated with chronic peptic ulcer - - - - - - - - 292
— early carcinomatous changes in - - - 292
— implanted dog's colon, resistance to digestion of 429
— reticulosarcoma of - - - - - - - 376
— torsion of, in strangulated diaphragmatic hernia 289
Stones, recurrent and residual, in common bile-duct 198
Strangulated diaphragmatic hernia, with torsion of stomach - - - - - - - - 289
— inguinofemoral hernia - - - - - - 331
— ulcerated incisional hernia - - - - - 329
Supernumerary lung - - - - - - - 327
Sweat-glands, metastasizing carcinoma of - - 80
Sword wounds of thorax and abdomen - - - 279
SWYNNERTON, B. F.: *See* TANNER, N. C., jt. auth.

TAGART, R. E. B.: Ruptured spleen - - 283
Talus, fracture-dislocation of, in childhood - 600
TANNER, NORMAN C.: *See* SMITH, CAREY C. K., jt. auth.
— — and SWYNNERTON, B. F.: Gastric tuberculosis associated with gastric carcinoma - 573
Tantalum prosthesis in resection of mandible - 255
TAYLOR, SELWYN: *See* ALHADEFF, ROBERT, jt. auth.
Tendons, flexor, repair of in hand - - - 35
Testis, descent through femoral canal in inguinofemoral hernia - - - - - - - - 331
THACKRAY, A. C.: *See* PATEY, DAVID H., jt. auth.
THOMAS, L. P.: *See* WILLIAMS, W. JONES, jt. auth.
Thorax, gunshot and sword wounds of - - - 279
Thorotrast angiography, granuloma of neck after - 638
Thrombo-endarterectomy for arterial reconstruction 449
Thrombosis, arteriosclerotic, as indication for arterial reconstruction - - - - - - - 458
— of internal carotid artery following injury - - 215
— primary as indication for arterial reconstruction 457
— secondary, affecting arteries of leg - - - 352
— venous, causing gangrene - - - - 591
Thyroid abscess - - - - - - - - 218
— carcinoma, clinico-pathological study - - 617
— gland, relationship of recurrent laryngeal nerve to 156
— — reticulosarcoma of, thyroidectomy for - - 376
— squamous-cell cysts of - - - - - 565
Thyroidectomy, vulnerability of recurrent laryngeal nerves during - - - - - - - 164
Tissues, regeneration of, in wound healing - - 141
TOMLINSON, B. E.: *See* MACIVER, I. N., jt. auth.
Torsion, omental - - - - - - - 315
Trauma, blood- and fluid-loss as a result of - - 193
Trichobezoar in childhood - - - - - - 441
Tuberculosis, gastric, associated with gastric carcinoma - - - - - - - 573
— at site of spondylolisthesis - - - - 502
Tumour(s), adenomatoid, of epididymis - - 512
— adenomatous, of anterior foregut region - - 248
— cartilaginous, of rib - - - - - - 116
— of diaphragm - - - - - - - 633
— heart, surgical treatment of - - - - 514
— jaw - - - - - - - - - 325
— kidney, segmental arteries in - - - 608
— malignant, of an aortic body - - - - 585
— primary, of rib - - - - - - - 113
— round-cell, of bone - - - - - - 380
— solitary, of skin - - - - - - - 196
— undifferentiated, malignant, of diaphragm - 633

ULCER(S), artificial, repair of, in urinary bladder of cat - - - - - - - - 99
— peptic, carcinoma of stomach associated with - 292

PAGE

Ulcer(s), peptic, perforated; immediate and long-term sequelæ - - - - - - 641
— venous, of leg, pathology and treatment - - 260
— — — surgical treatment of - - - - 272
Ureter, impacted stone in causing ureterocolonic fistula - - - - - - - - - 646
Ureterocolonic fistula associated with abscess and fæcal fistula - - - - - - - 646
Ureterocolostomy, prevention of complications of - 650
Urinary steroid response to operation - - - 390

VAN DEN BRENK, H. A. S.: Studies in restorative growth processes in mammalian wound healing - - - - - - - - - 525
Vascular disorders, peripheral, coexisting with orthopædic conditions - - - - - 665
— reconstruction, methods of - - - - - 449
— surgery, effects of different blood-vessel clamps 561
Vein graft, autogenous, in arterial reconstruction - 450
Venography in leg ulcers - - - - - - 269
Venous system of leg, anatomy and physiology of - 263
— ulcers of leg, pathology and treatment of - - 260
— — — surgical treatment of - - - - 272
Vertebral angiography: percutaneous lateral atlanto-occipital method - - - - - 1
Vessel wall, effects of different arterial clamps on - 561
Visits to Clinics:—
The neurosurgical clinic and the neurosurgical laboratories at the Royal Infirmary, Manchester - - - - - - - - 317
Vitamin B_{12} in treatment of megaloblastic anæmia following gastrectomy - - - - - 426
Volvulus, acute, of stomach - - - - - 588

WADE, J. S. H.: Vulnerability of the recurrent laryngeal nerves at thyroidectomy - - 164
WAPSHAW, HENRY: Radiographic and other studies of the biliary and pancreatic ducts - - 132
WATSON, A. B.: Some remarks on the repair of flexor tendons in the hand, with particular reference to the technique of free grafting - 35
WEBSTER, D. R.: *See* IRVINE, W. T., jt. auth.
WELBOURN, R. B., NELSON, M. G., and ZACHARIAS, F. J.: Megaloblastic anæmia following gastric resection. Report of ten cases - - 422
— — *See* CAPPER W. MELVILLE, jt. auth.
WHITBY, J. D.: *See* MACIVER, I. N., jt. auth.
WHITEHEAD, RAYMOND: *See* NICHOLSON, FRANK, jt. auth.
WHYTEHEAD, L. L.: *See* BROCK, Sir RUSSELL, jt. auth.
WILLIAMS, A. WYNN: *See* BURNETT, W., jt. auth.
WILLIAMS, W. JONES, and THOMAS, L. P.: Metastasis of gastric carcinoma to the spermatic cord and intestinal tract - - - - 204
WILSON, A. O.: Electrolyte content of muscle samples obtained at surgical operations - 71
WILSON, J. N.: Fractures of the external condyle of the humerus in children - - - 88
WOOD, KENNETH: Lymphatic cysts of the mesentery. A review of the literature and a report of two cases - - - - - - - 304
Wound(s), contraction in experimental healing 536–44
— cutaneous, histogenesis of healing of - - 141
— excised, healing of - - - - - - 145
— of the head, missile - - - - - - 628
— healing, experimental restorative growth processes in - - - - - - - - 525
— incised, healing of - - - - - - - 142
WYNDHAM, NORMAN: The significance of gastric mucosa in the œsophagus - - - - 409

YOUNG, DONALD: Cholelithiasis simulating pyloric neoplasm - - - - - - 105

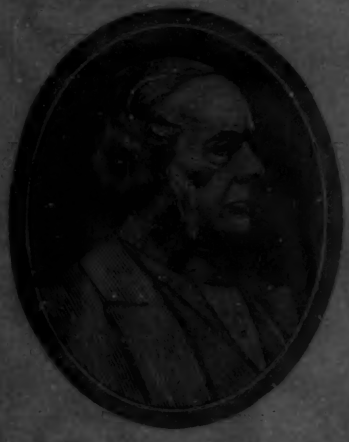
ZACHARIAS, F. J.: *See* WELBOURN, R. B., jt. auth.

DOES NOT CIRCULATE

L. XLIII ISSUED IN ALTERNATE MONTHS No. 182

UNIVERSITY OF MICHIGAN
AUG 21 1956
MEDICAL LIBRARY

The British Journal of Surgery



LISTER

MAY, 1956

BRISTOL: JOHN WRIGHT & SONS LTD.

WHOLESALE DISTRIBUTORS: WM. DAWSON & SONS LTD.
10-12 MACKLIN STREET LONDON W.C.2.

UNITED STATES OF AMERICA: THE WILLIAMS & WILKINS COMPANY, BALTIMORE, Sole Agents

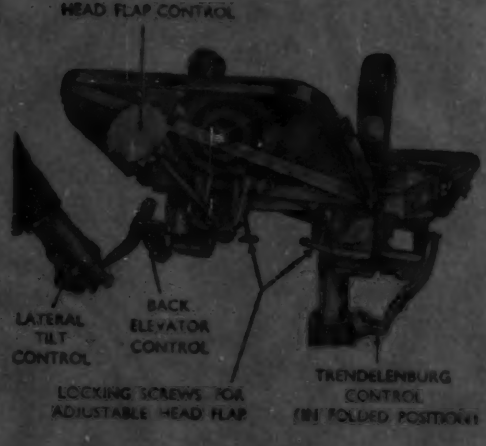
Entered as second class matter at the Post Office at BALTIMORE under Act of March 3, 1879.

HEAD END CONTROL

with RIGIDITY

Incorporating head-end control with no sacrifice of rigidity, enabling all major adjustments to the position of the table to be made without interruption of the surgical team, the new A & H Model J Operation Table has been specially designed to meet the exacting requirements of modern surgical technique.

In this Operation Table, with its many improvements and its unlimited versatility, undisputed leadership in design is uniquely allied to the reliability, craftsmanship and quality which have been associated with the name Allen & Hanburys for over 200 years. An illustrated manual will be supplied on application.


HEAD FLAP CONTROL
LATERAL TILT CONTROL
BACK ELEVATOR CONTROL
LOCKING SCREWS FOR ADJUSTABLE HEAD FLAP
TRENDELENBURG CONTROL (IN FOLDED POSITION)

Manufactured in England by

ALLEN & HANBURYS LTD LONDON E2

Makers of Quality Instruments

SHOWROOMS: 48 WIGMORE STREET LONDON W1

THE BRITISH JOURNAL OF SURGERY

UNDER THE DIRECTION OF THE FOLLOWING EDITORIAL COMMITTEE

*SIR JAMES PATERSON ROSS (London), *Chairman*

IAN AIRD (London)
*HEDLEY ATKINS (London)
J. C. BARRETT (Leicester)
GERALDINE M. BARRY (London)
MICHAEL BOYD (Manchester)
C. V. BRAIMBRIDGE (Colonial Medical Service)
SIR RUSSELL BROCK (London)
F. R. BROWN (St. Andrews)
EARDLEY BUTTON (Wellington)
SIR STANFORD CADE (London)
DIGBY CHAMBERLAIN (Leeds)
SURGEON CAPTAIN H. L. CLEAVE (Naval Medical Service)
A. J. CRAIG (Malta)
SIR HAROLD DEW (Sydney)
V. W. DIX (London)
AIR COMMODORE F. W. P. DIXON (Royal Air Force Medical Branch)
WILLIAM DOOLIN (Dublin)
HAROLD EDWARDS (London)
*SIR ERNEST FINCH (Sheffield)
W. B. GABRIEL (London)
W. E. GALLIE (Toronto)
W. GISSANE (Birmingham)
GEOFFREY HADFIELD (London)
C. S. HALLPIKE (London)
B. B. HICKEY (Sudan Medical Service)
BRIGADIER J. HUSTON (Army Medical Services)
C. F. W. ILLINGWORTH (Glasgow)
T. G. ILLTYD JAMES (London)
T. P. KILNER (Oxford)
E. F. KING (London)
L. C. E. LINDON (Adelaide)
J. H. LOUW (Cape Town)
J. A. McFARLANE (Toronto)
*RALPH MARNHAM (London)
A. D. MARSTON (London)
S. J. MEHTA (Bombay)
COLONEL S. A. MIAN (Rawalpindi)
T. M. MILLAR (Edinburgh)
V. L. PARMAR (Bombay)
MILROY PAUL (Colombo)
W. G. PENFIELD (Montreal)
VERNON PENNELL (Cambridge)
R. S. PILCHER (London)
*SIR ARTHUR PORRITT (London)
R. W. REID (Colchester)
*E. W. RICHES (London)
C. G. ROB (London)
DOUGLAS ROBB (Auckland)
R. H. O. B. ROBINSON (London)
H. W. RODGERS (Belfast)
LAMBERT ROGERS (Cardiff)
HENRY SEARBY (Melbourne)
H. J. SEDDON (London)
F. A. R. STAMMERS (Birmingham)
N. C. TANNER (London)
W. UNDERWOOD (Johannesburg)
*R. MILNES WALKER (Bristol)
CHARLES WELLS (Liverpool)
A. HEDLEY WHYTE (Newcastle upon Tyne)
W. C. WILSON (Aberdeen)

*SIR CECIL WAKELEY, Bt. (London), *Editorial Secretary*

*Constitute the Executive Committee

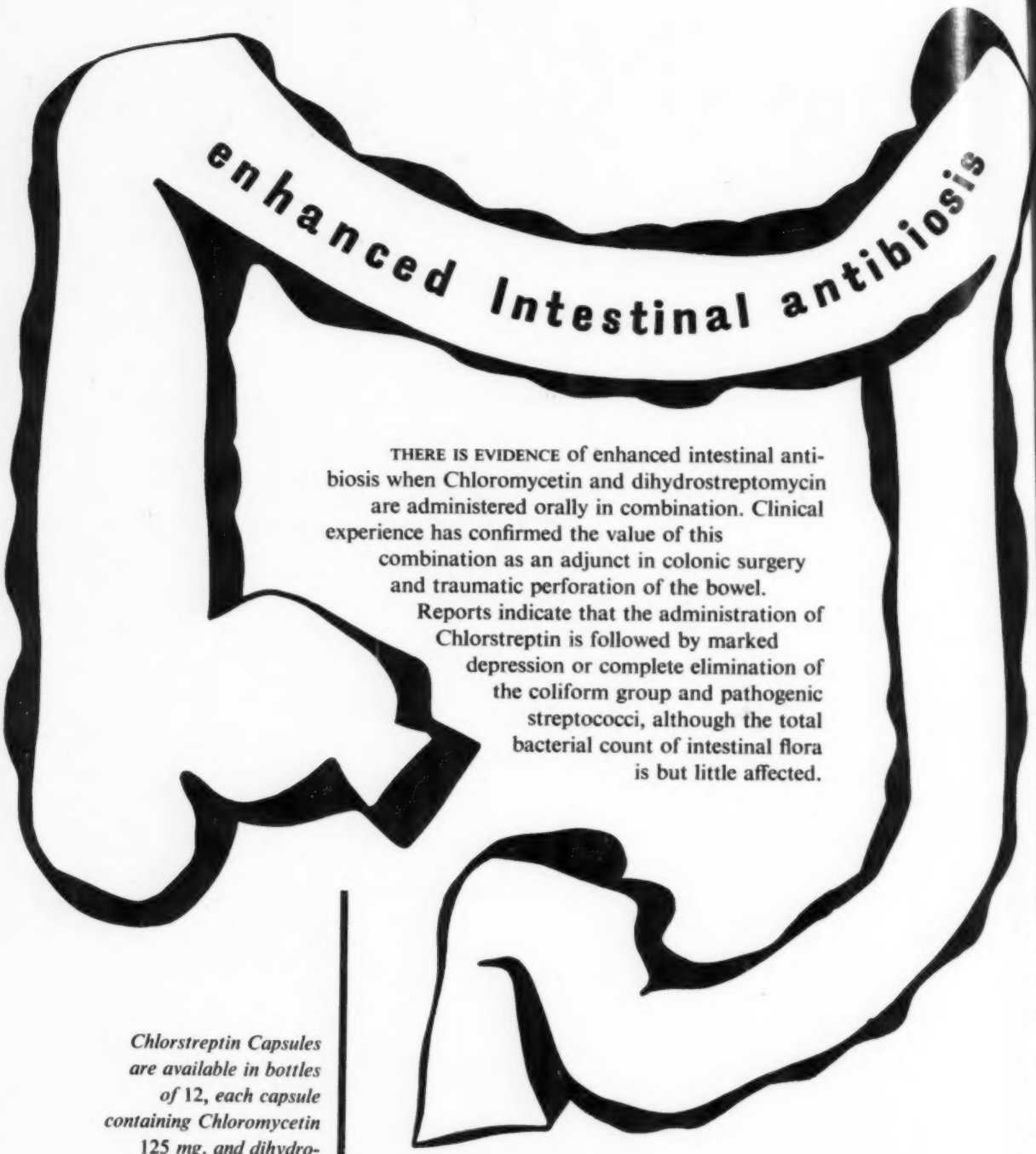
MAY, 1956

ISSUED IN ALTERNATE MONTHS
Subscription 84/- per annum, post free

BRISTOL: JOHN WRIGHT & SONS LTD.

WHOLESALE DISTRIBUTORS: WM. DAWSON & SONS LTD.
10–12 MACKLIN STREET, LONDON, W.C.2

TORONTO: THE MACMILLAN CO. OF CANADA LTD.
CALCUTTA: BUTTERWORTH AND CO. (INDIA) LTD. SYDNEY: ANGUS AND ROBERTSON LTD.
UNITED STATES OF AMERICA: THE WILLIAMS AND WILKINS COMPANY, BALTIMORE *Sole Agents*



THERE IS EVIDENCE of enhanced intestinal antibiosis when Chloromycetin and dihydrostreptomycin are administered orally in combination. Clinical experience has confirmed the value of this combination as an adjunct in colonic surgery and traumatic perforation of the bowel.

Reports indicate that the administration of Chlorstreptin is followed by marked depression or complete elimination of the coliform group and pathogenic streptococci, although the total bacterial count of intestinal flora is but little affected.

Chlorstreptin Capsules are available in bottles of 12, *each capsule containing Chloromycetin* 125 *mg. and dihydrostreptomycin* 125 *mg. Also available is Chlorstreptin Suspension which is supplied in bottles of* 60 *ml.*

CHLORSTREPTIN

a two-fold antibiotic preparation

* *Trade Mark*

PARKE, DAVIS & COMPANY LTD. *Inc.* (*U.S.A.*) HOUNSLOW, MIDDX. Telephone Hounslow 2361

The British Journal of Surgery

CONTENTS, MAY, 1956

ORIGINAL PAPERS

		PAGE
A Comparative Study of the Effects of Different Arterial Clamps on the Vessel Wall	*G. F. Henson and C. G. Rob*	561
Squamous-cell Cysts of the Thyroid	*H. M. Goldberg and Peter Harvey*	565
Hypothermia as an Aid to Surgery	*D. N. Ross*	569
Gastric Tuberculosis associated with Gastric Carcinoma	*N. C. Tanner and B. F. Swynnerton*	573
The Negative X-ray Report in Cancer of the Colon	*Gordon S. Ramsay*	576
Metastasizing Insulinoma with Hypoglycæmia	*R. Cunliffe Shaw*	579
Chemodectoma of an Aortic Body	*D. A. Gillis, D. P. Reynolds, and J. W. Merritt*	585
Acute Volvulus of the Stomach	*H. M. Goldberg and Vernon H. Smith*	588
Gangrene of Venous Origin	*R. F. Moore and G. B. D. Scott*	591
Atypical Head Injuries illustrating General Therapeutic Principles	*C. B. Sedzimir*	595
Fracture-dislocation of the Talus in Childhood	*N. A. Stephens*	600
The Anatomy of the Intrarenal Arteries in Health and Disease	*F. T. Graves*	605
A Clinico-pathological Study of Thyroid Carcinoma	*Robert Alhadeff, Foster Scott, and Selwyn Taylor*	617
Conjoined Twins	*John Holgate and B. J. Ikpeme*	626
Missile Head Wounds in the Korean Campaign	*Walpole Lewin and R. Myles Gibson*	628
Tumours of the Diaphragm	*Frank Nicholson and Raymond Whitehead*	633
Granuloma of the Neck following Thorotrast Angiography	*Laurence F. Levy*	638
Perforated Peptic Ulcer: the Immediate and Long-term Sequelæ	*A. Tom Matheson*	641
A Case of Spontaneous Left Ureterocolonic Fistula associated with an Abscess in the Left Loin and Fæcal Fistula	*A. H. Haysom*	646

EXPERIMENTAL SURGERY

Prevention of the Late Complications of Ureterocolostomy by Methods of Fæcal Exclusion	*W. T. Irvine, C. Allan, and D. R. Webster*	650

SHORT NOTES OF RARE OR OBSCURE CASES

Gas Gangrene of the Colon in a Newborn Infant	*E. Haigh*	659
A Carcinoma of the Third Part of the Duodenum	*Frank Forty*	661
Meckel's Diverticulum with Mesenteric Abscess	*David Duncan*	664
A Case of Unsuspected Arterial Disease	*G. F. Henson*	665
A Case of Fæcal Contamination of the Pleura and Gastro-colic Communication following Gunshot Injury	*Gerson Katz*	666

REVIEWS AND NOTICES OF BOOKS

Modern Trends in Orthopædics—ed. *Sir Harry Platt.* Outline of Orthopædics—*John Crawford Adams.* Manual of Hand Injuries—*H. Minor Nichols.* Chirurgie des Glandes Salivaires—*Henri Redon.* Le Cancer du Plancher de la Bouche—*Marcel Dargent and Jean Papillon.* Roentgen Interpretation—*George W. Holmes and Laurence L. Robbins.* Management of Pain in Cancer—ed. *M. J. Schiffrin.* Surgery of the Ambulatory Patient—*L. Kraeer Ferguson.* Clinical Neurosurgery—Proceedings of the Congress of Neurological Surgeons, New York. Alfred Hospital: Clinical Reports, 1955—ed. *R. S. Lawson.* Advances in Pediatrics, Vol. VIII—ed. *S. Z. Levine.* Thomas Fairbank Birthday Volume—Journal of Bone and Joint Surgery. Chest X-ray Diagnosis—*Max Ritvo.* A Manual of Practical Obstetrics—*O'Donel Browne.* Basic Surgical Skills—*Robert Tauber* — 668

EDITORIAL NOTICES

EDITORIAL COMMUNICATIONS should be addressed to the *Editorial Secretary, British Journal of Surgery, c/o John Wright & Sons Ltd., Bristol.*

Original Articles are invited, and may be sent if desired to any other member of the Editorial Committee: they are accepted with the understanding that they are contributed to this Journal only, and that articles and their illustrations become the property of the Journal unless the authors state, before publication, that they reserve the rights to themselves.

REPRINTS can be supplied at a reduced price if authors will indicate their requirements at the time that proofs are returned. The following scale will be helpful as a guide to the cost; 50 copies are suggested as a minimum number.

PAGES	NUMBER REQUIRED																							
	50			100			150			200			250			300			400			500		
2	£1	0	0	£1	5	0	£1	10	0	£1	14	0	£1	17	0	£ 2	0	0	£ 2	5	0	£ 2	10	0
4	1	15	0	2	4	0	2	13	0	3	0	0	3	5	0	3	10	0	3	19	0	4	8	0
6	2	10	0	3	2	6	3	15	0	4	5	0	4	12	6	5	0	0	5	12	6	6	5	0
8	3	0	0	3	15	0	4	10	0	5	2	0	5	11	0	6	0	0	6	15	0	7	10	0
10	3	10	0	4	7	6	5	5	0	5	19	0	6	9	6	7	0	0	7	17	6	8	15	0
12	4	0	0	5	0	0	6	0	0	6	16	0	7	8	0	8	0	0	9	0	0	10	0	0
14	4	10	0	5	12	6	6	15	0	7	13	0	8	6	6	9	0	0	10	2	6	11	5	0
16	5	0	0	6	5	0	7	10	0	8	10	0	9	5	0	10	0	0	11	5	0	12	10	0
Printed Covers	£1	12	6	£1	17	6	£2	2	6	£2	7	6	£2	12	6	£ 2	17	6	£ 3	7	6	£ 3	17	6

An additional charge will be made for reprints containing coloured illustrations, depending upon the amount of extra work involved.

BUSINESS COMMUNICATIONS should be addressed to *John Wright & Sons Ltd., British Journal of Surgery, Bristol.* Remittances should be made payable to *The British Journal of Surgery.*

BINDING.—Handsome Cloth Cases may be obtained for binding Vol. xlii. Cases are also available for some of the earlier volumes. Applications should be made to the Publishers, who will also undertake the binding if desired. Case 8s. 6d., post free; Case and binding 21s. post free.

BACK NUMBERS.—The Publishers would be glad to purchase copies in good condition of No. 168, Vol. xli, No. 133, Vol. xxxiv, and No. 126, Vol. xxxii.

INSTRUCTIONS TO AUTHORS

PREPARATION OF MS.—Papers should be submitted in typescript and the author should retain a carbon copy. Double spacing should be used throughout, except for quotations.

TABLES AND ILLUSTRATIONS.—Tables should be numbered in roman numerals and set out on sheets separate from the text. Illustrations, too, should be kept separate from the text and should be numbered consecutively in arabic numerals. Each figure should be referred to in the text, and the descriptive legends should be typewritten on a separate sheet of paper, and not put on the backs of the originals. Glossy photographs should be supplied and prints should be sent whenever possible in preference to X-ray negatives. Drawings should be in a finished state suitable for reproduction.

REFERENCES.—The Harvard System should be followed.

In this system the name of the author and the date of the publication are given in the text; the list of authors quoted is put at the end of the article in alphabetical order. Each reference in the list should give, in order, the author's name, initials, the year of publication (in brackets), the full title of the paper,* the name of the journal, the volume (in heavy type arabic numerals), and the number of the first page of the paper. If the author cited has written more than one paper in the year, each should be distinguished by the letters a, b, and c, etc. For books, the place of publication should be stated and the publisher's name. The names of collaborating authors should be given in full on the first occasion, but in later citations the words "and others" should follow the first name.

Abbreviations for journals should be those adopted in the "WORLD LIST OF SCIENTIFIC PERIODICALS" (1952).

Only in papers in which many and frequent references have to be made should the items be numbered; the numbers may then be inserted in the text without interrupting it with a list of names.

* As an economy at the present time, the title of the paper may be omitted.

XYLOTOX

Local Anaesthetic

contains

The Original BRITISH MADE

LIGNOCAINE

(ω–diethylamino–2,6–dimethylacetanilide)

for

Minor and Major Surgery

½%, 1% & 2% Solutions
with or without adrenaline

Surface Application

4% Solution: with or without
adrenaline. 5% Paste in tubes

Made in England by the makers of Novutox Local Anaesthetic

★ ***Literature and samples forwarded upon request***

PHARMACEUTICAL MANUFACTURING COMPANY

The Local Anaesthetic Specialists

ASHLEY WORKS · EPSOM · SURREY

In the service of mankind

In 1854 Florence Nightingale went to the Crimea where the military hospitals were in an indescribable state of dirt and disease. She set out with thirty-seven nurses, became the Lady of the Lamp and returned to lay the foundation of a nursing profession honoured all over the world. In the brighter era which now opens for the nurse's career J. H. Bounds Ltd. will continue to serve her in the matter of equipment with as much zeal and knowledge as in the past. J. H. Bounds Ltd. have rendered pioneer service in the design and supply of Nurses' Uniforms and Hospital Textiles, and offer a specialist consulting service to Regional Hospital Management Committees and Matrons.

Serving the needs of the Hospital

J.H. Bounds LIMITED

TELEPHONES: CENTRAL 7331-4 · 4 LINES
TELEGRAMS: TENDER, MANCHESTER

STETHOS HOUSE 68 SACKVILLE STREET · MANCHESTER · 1

*Furadantin**

BRAND OF NITROFURANTOIN

in urinary tract infections

Furadantin is an antibacterial compound for the oral treatment of urinary tract infections only. Therapeutic concentrations up to 400 mcg./ml. appear in the urine but blood and tissue concentrations are very small. The drug is effective against most organisms found in the urinary tract, including *Proteus* and *Aerobacter*, and some strains of *Pseudomonas*.

Advantages

- Oral administration
- Broad antibacterial spectrum
- Action confined to urinary tract
- Only minor side-effects

Furadantin, (brand of nitrofurantoin) is available as tablets of 50 mg. in bottles of 25 or 250.

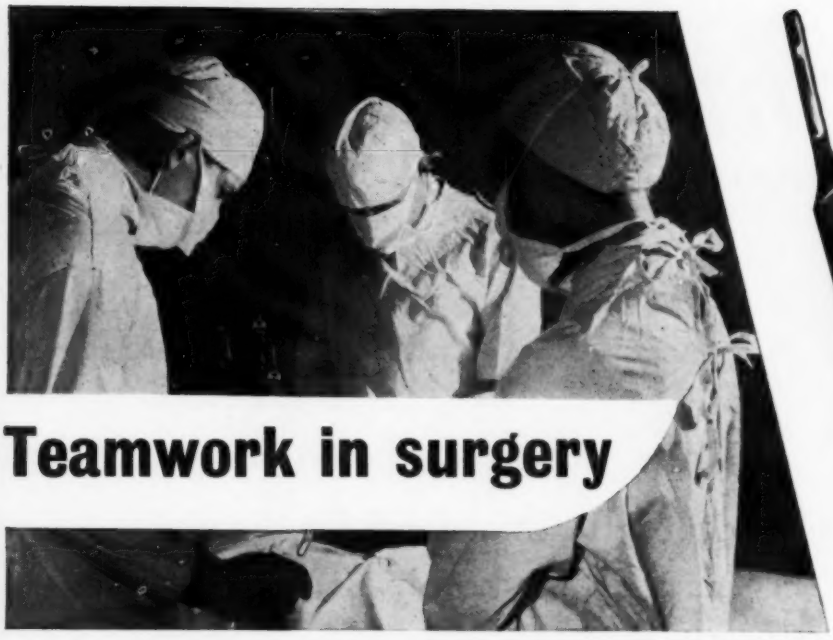
Further information on the use of Furadantin, or Diagnostic Tablets for bacterial sensitivity tests, will be sent on request.

DUNCAN, FLOCKHART & CO., LTD.

104-8 Holyrood Rd.,
EDINBURGH, 8

4 Carlos Place,
LONDON, W.1.

* *Furadantin is manufactured by a registered user of the trade mark under licence from the Norwich Pharmacal Company (Eaton Laboratories Division).*



Teamwork in surgery

Behind the small, highly trained team in the operating theatre, there stands another team, trained for different work, but equally painstaking, enthusiastic and accurate.

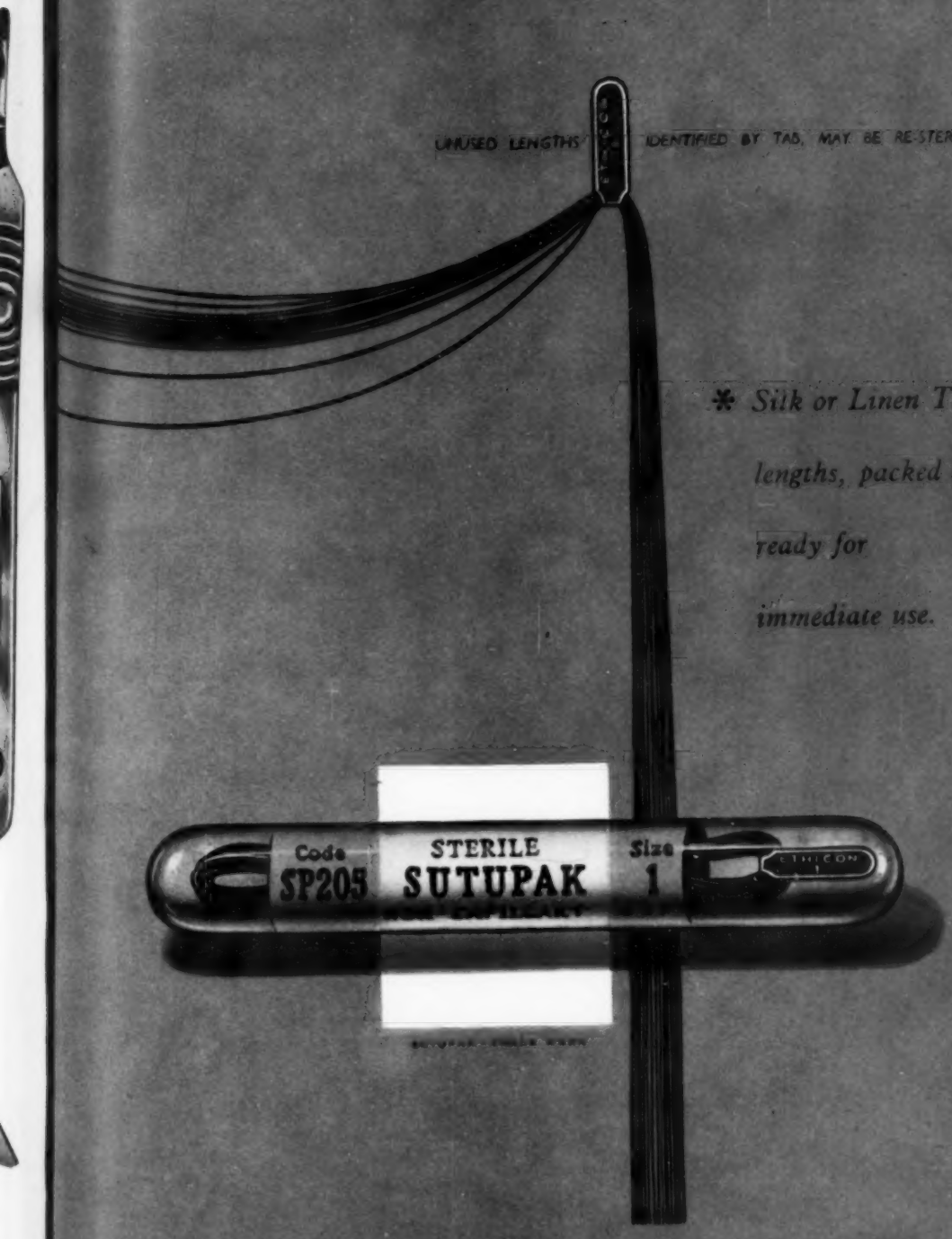
This supporting team produces the equipment which makes modern operative techniques possible. And scalpels are an important item of this equipment. Every Swann-Morton scalpel blade is individually inspected, each of the traditional shapes identical to pattern, perfectly tempered, ground and finished.

Produced in a model factory in Sheffield, Swann-Morton blades are in growing demand all over the world.

Swann-Morton **SURGICAL BLADES AND HANDLES**

3 types of handle—11 traditional shapes of blade.

W. R. SWANN & CO. LTD. • SHEFFIELD 6 • ENGLAND



* *Silk or Linen Thread in pre-cut lengths, packed dry and sterile ready for immediate use.*

ETHICON

Edinburgh

NOW COST NO MORE THAN STANDARD 5ft SUTURE LENGTHS

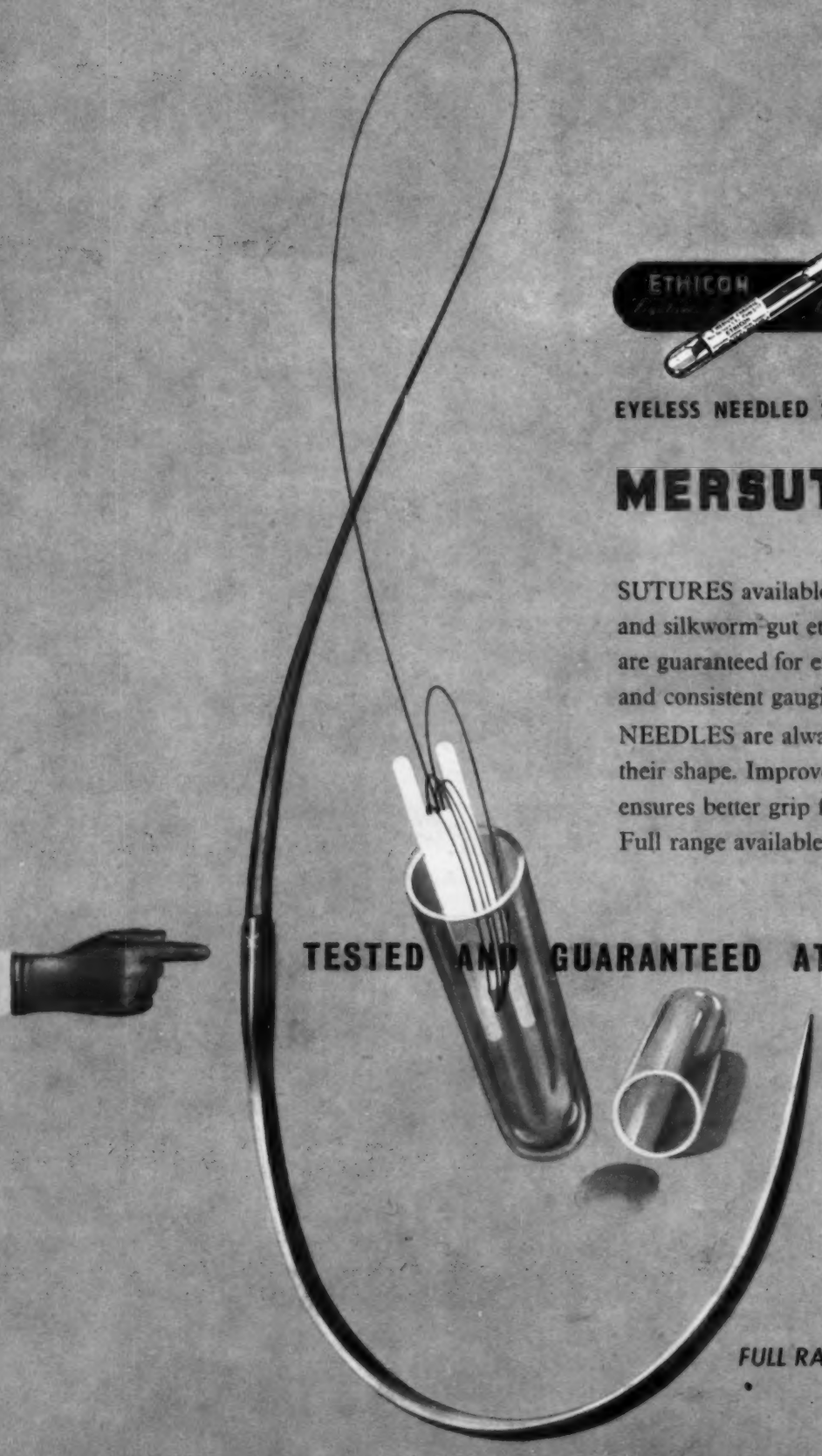
EYELESS NEEDLED SUTURES

MERSUTURES

Regd.

SUTURES available with catgut, silk and silkworm gut etc. Ethicon Sutures are guaranteed for extra tensile strength and consistent gauging.

NEEDLES are always sharp, retain their shape. Improved flattened area ensures better grip for needle holder. Full range available.



TESTED AND GUARANTEED ATTACHMENT

FULL RANGE AVAILABLE

'I think it's my nerves, doctor.' It has been calculated that 2 in 6 prescriptions under the NHS are for 'nerves'*. These patients, who may present with a bewildering variety of vague non-organic signs and symptoms, all have one thing in common — they worry too much. Since this lessens their ability to deal with routine problems a vicious spiral of increasing worry and decreasing competence is set up. Combined with a doctor's advice and reassurance 'Drinamyl' gives these patients a holiday from tension. By inducing a mood of cheerful calmness, without drowsiness or inappropriate euphoria, it enables them to take a fresh look at their situation. Imaginary worries are set aside and energy sensibly apportioned to deal with matters of real concern.

'Drinamyl'

for the harassed patient

Available for prescription in containers of 100 tablets

'Drinamyl' is also available in 'Spansule' brand sustained release capsules

SMITH KLINE & FRENCH INTERNATIONAL CO. | represented by **Menley & James, Limited,** Coldharbour Lane, London, S.E.5

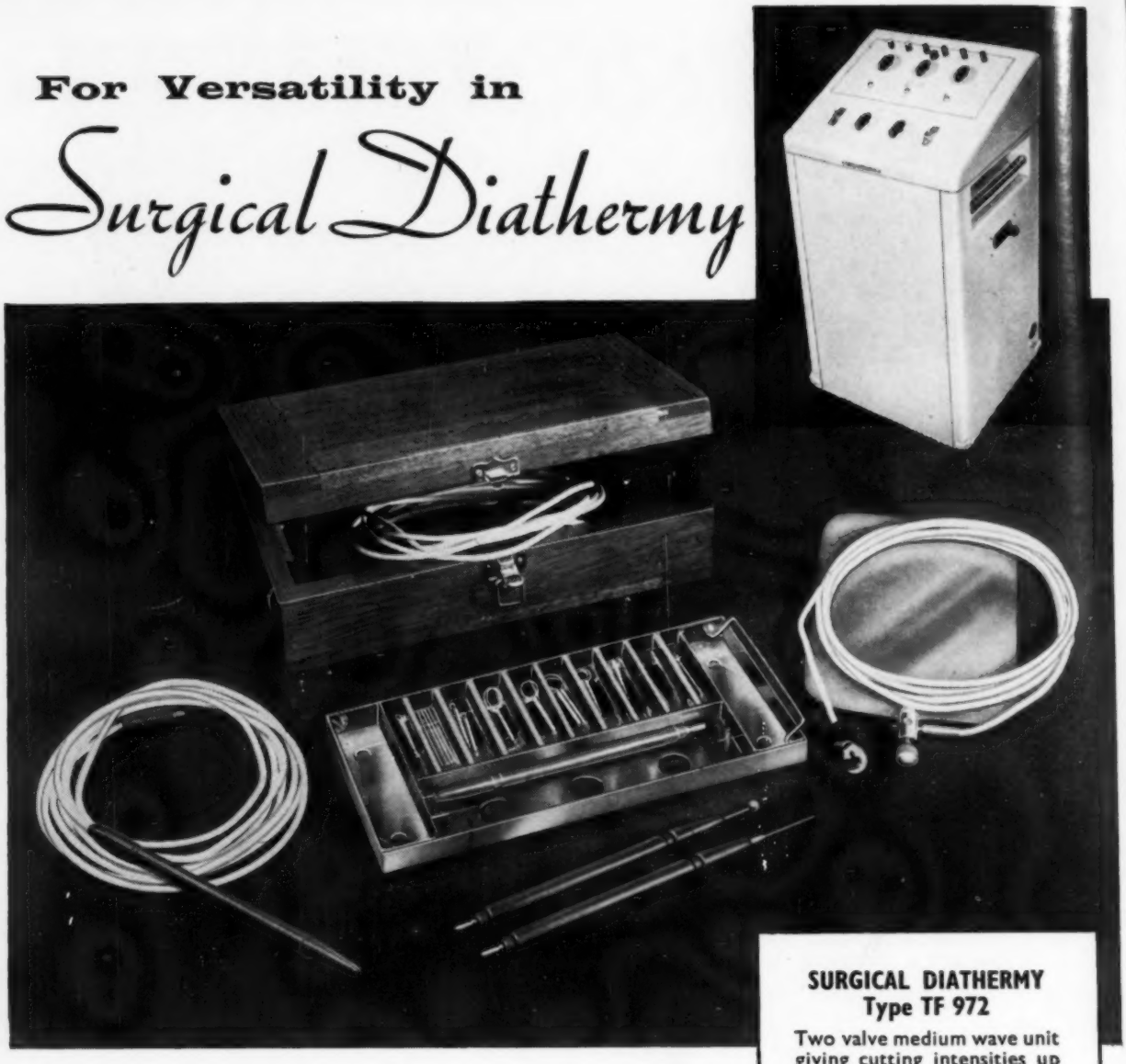
*'Drinamyl' and 'Spansule'† are registered trade marks †Brit. Pat. No. 715,305 *Quoted in Lancet (1955 ii, 14)*

Obtainable in the Republic of Ireland

DLP26

For Versatility in

Surgical Diathermy



Marconi equipment for surgical diathermy combines versatility, greater efficiency and simplicity of operation. The control unit provides individual electrical circuits for cutting and coagulation, pre-selected by a foot switch, with independant continuously-variable controls giving maximum cutting intensities up to 300 watts. Model TF 972/1 incorporates a Cautery/Light unit with three quite separate outlets for cautery, endoscopy and surgeons' lamps.

The surgical electrodes for use with these units have been designed for general electro-surgical procedures and will meet all normal requirements, with special reference to the needs of the cranial and neurological surgeon.

SURGICAL DIATHERMY
Type TF 972

Two valve medium wave unit giving cutting intensities up to 300 watts.

Type TF 972/1

As above, with Cautery/Light unit incorporated

SURGICAL ELECTRODES
Type TM 3548B

For general electro-surgical procedures

MARCONI INSTRUMENTS

SPECIALISTS IN : DIATHERMY · AUDIOMETRY
ELECTRO-ENCEPHALOGRAPHY · THERAPEUTIC
AND DIAGNOSTIC X-RAYS

MARCONI INSTRUMENTS LTD · ST. ALBANS · HERTFORDSHIRE · TELEPHONE: ST. ALBANS 6160/9
30 Albion Street · Kingston-upon-Hull · Telephone: Hull Central 16144
19 The Parade · Leamington Spa · Telephone: 1408
Managing Agents in Export: MARCONI'S WIRELESS TELEGRAPH CO. LTD., MARCONI HOUSE, STRAND, W.C.2.

EM11

Thromboral

A treatment for Hæmorrhagic ulcers occurring in the alimentary canal

THROMBORAL has been developed for the systemic control of haemorrhagic complications of peptic and duodenal ulcers; bleeding from ruptured oesophageal varices; denuded buccal ulcer and cases of epigastric distress exhibiting signs of internal haemorrhage.

THROMBORAL contains active THROMBIN in massive doses, the instantaneous haemostatic effect of which is preserved by reduction of the pH of the gastric mucosa. Natural physiological coagulation occurs at the site of bleeding.

THROMBORAL is presented as a complete treatment for oral administration over a 24 hour period.

THROMBORAL can be of inestimable value where the age or physical condition of the patient makes surgical intervention undesirable.

MAW'S Ethical Products also include

NAPHTHIONIN A haemostatic of general action for administration by the parenteral route; used pre-operatively or post-operatively.
Naphthionin does not control haemophiliac bleeding for which Thrombin (Maw) is the haemostatic of choice.

THROMBIN (MAW) A haemostatic for topical use in surgical procedures for the immediate arrest of haemorrhage.

THROMBOPLASTIN (MAW) For reagent use in the determination of the prothrombin time in anticoagulant therapy.

REAZIDE (Cyanacetic Acid Hydrazide) A new hydrazide for specific use in all forms of tuberculosis. Clinical trial in progress.

HEMATRIX An ointment for the treatment of haemorrhoids, pruritus ani and painful, inflammatory, pruritic and eczematous lesions of the skin in the anal region. Prescribable on E.C.10.

Further information available on request from Dept. JS

Maw's

ETHICAL PRODUCTS

S Maw Son and Sons Limited Barnet England

NOW— THE NEW ALL-IN QUICK MIX ACID HARDENING FIXING SALT

Every X-ray department will welcome the new Ilford IF-22 X-ray Acid Hardening Fixing Salts. It greatly reduces the risk of abrasion and damage when films are handled wet, and it promotes rapid drying.

reasons why you should specify ILFORD IF-22

Ilford IF-22 is supplied as a ready-mixed, free-flowing powder and has the following advantages:

- SPECIALLY FORMULATED FOR RADIOGRAPHIC USE
- REQUIRES ONLY ONE MIXING OPERATION
- DISSOLVES QUICKLY IN COLD WATER
- RETAINS FULL HARDENING POWER THROUGHOUT WORKING LIFE
- SUITABLE FOR ELECTROLYTIC METHODS OF SILVER RECOVERY

ILFORD IF-22

PACKINGS & PRICES	TO MAKE	PRICE
Ilford IF-22 is supplied in tins in a range of sizes to meet the needs of every radiographic department, large or small.	80 oz. (2.25 litres)	5/3
	1 gall. (4.5 litres)	7/6
	2 gall. (9 litres)	12/9
	3 gall. (13.5 litres)	17/3
	5 gall. (22.5 litres)	27/0

X-RAY ACID HARDENING FIXING SALT

Ilford Limited · Ilford · London

'Largactil' as a premedicant

Before operative procedures, the administration of chlorpromazine as part of the premedication calms the patient and induces a unique state of tranquillity.

During the procedure, the 'Largactil' already administered enhances the activity of the analgesic and anaesthetic agents used, so that their effective doses can be considerably reduced. In addition, chlorpromazine affords a measure of protection against shock.

After the patient has left the theatre, certain usual effects of chlorpromazine premedication are maintained. Recovery from the anaesthetic is smooth and uneventful, and there is usually complete freedom from nausea and vomiting. The tranquillity which characterizes chlorpromazine therapy persists, and natural sleep follows in the majority of patients.

Detailed information is available on request.

'Largactil'
trade mark brand
CHLORPROMAZINE HYDROCHLORIDE
MANUFACTURED BY M&B MAY & BAKER LTD

PRESENTATIONS: **Tablets**—10, 25, *and* 100 *mgm.* **Syrup**—*containing* 25 *mgm. per* 3·6 *c.c.* (*approx.* 1 *teaspoonful*). **Solutions for injection**—1% *in* 5 *c.c. ampoules;* 2·5% *in* 1 *c.c. and* 2 *c.c. ampoules.* **Suppositories**—*containing* 100 *mgm. chlorpromazine base.*

M&B *brand Medical Product* MA3079

Distributors: PHARMACEUTICAL SPECIALITIES (MAY & BAKER) LTD · DAGENHAM · ESSEX

Thackray Operation Table

NEW UNIVERSAL MODEL OF IMPROVED DESIGN

New Universal Model with divided trunk section and lateral tilt device. Enables a large variety of positions to be obtained for General and Specialized branches of surgery — thoracic, gynæcological, urological, neurological. Originally designed in 1929, Thackray Tables have 25 years of service behind them. As in the original model, its modern counterpart is fitted with a *large rigid handwheel at the head end (under the direct control of the Anæsthetist) for operating the Trendelenburg (and reversed Trendelenburg) position.*

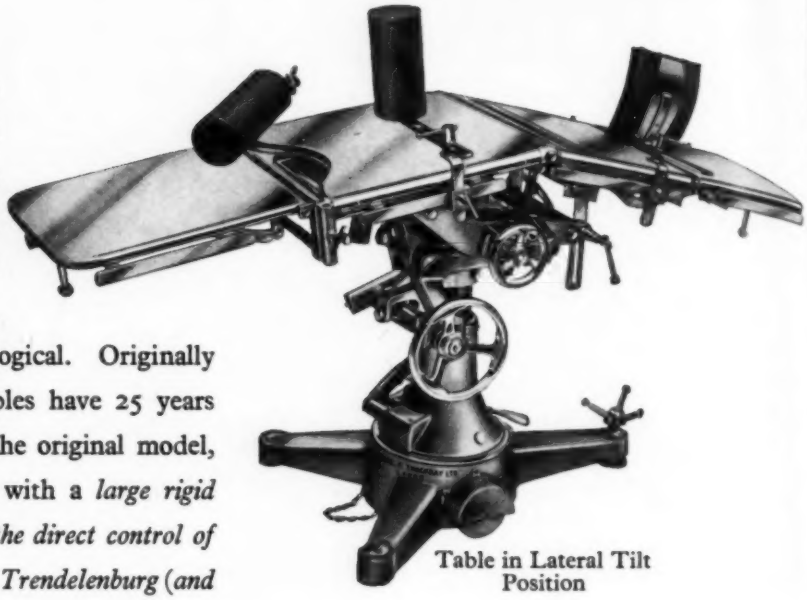


Table in Lateral Tilt Position

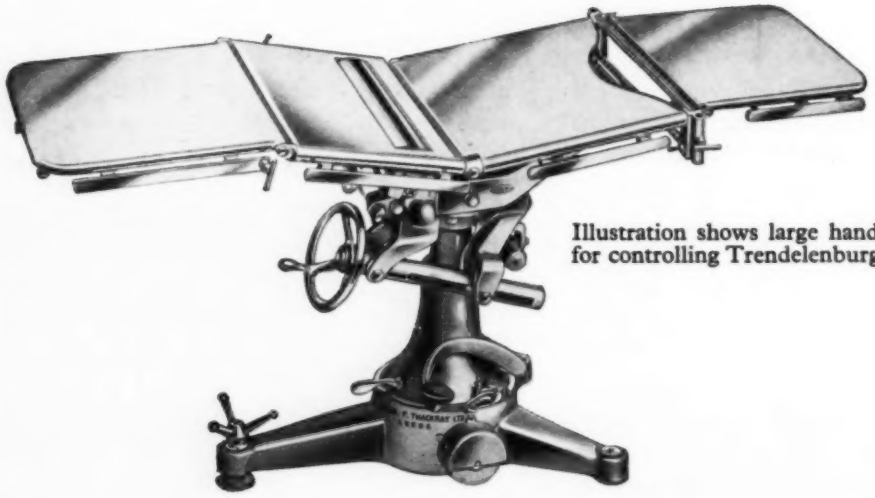


Illustration shows large handwheel under head end for controlling Trendelenburg position.

"Modern Operation Tables"—a catalogue showing complete range of available models, gladly sent on request.

Chas. F. Thackray LTD
LEEDS & LONDON

Head Office: THE OLD MEDICAL SCHOOL PARK ST. LEEDS 1
38 WELBECK STREET LONDON W1
Also at: CAPE TOWN and JOHANNESBURG

Manufacturers of Surgical Instruments, Hospital Furniture and Sterilizing Equipment

A PRESSOR AGENT

with unique properties

'Vasoxine' produces a rapid, powerful and prolonged rise in blood pressure without cardiac or cerebral stimulation. It acts within 1-2 minutes after intravenous injection, and about 20 minutes after intramuscular injection, the action being maintained for an hour or more.

Tachycardia is not produced by 'Vasoxine' injection, rather does it cause bradycardia, thus sparing the heart muscle.

'Vasoxine' does not increase cardiac output.

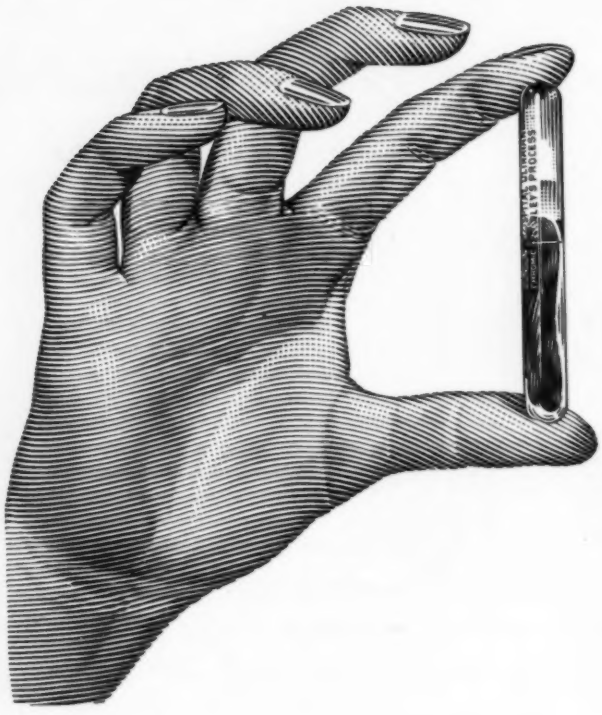
Because of its unique properties it is especially indicated in hypotension after spinal analgesia. It has been described as a safe pressor agent in cyclopropane anæsthesia.

'Vasoxine' is available in boxes of 6 and 25 ampoules of 1 c.c., each containing 20 mgm. of methoxamine hydrochloride.

'VASOXINE' BRAND

INJECTION OF METHOXAMINE HYDROCHLORIDE

BURROUGHS WELLCOME & CO. (THE WELLCOME FOUNDATION LTD.) LONDON



London Hospital Catgut

. . . A CONTRIBUTION TO SURGICAL HISTORY

FOLLOWING EXTENSIVE RESEARCH in the Ligature Laboratories, a special report was made to the Medical Research Council. In consequence the Ministry of Health brought the preparation of Sterilised Surgical Catgut in England under the Therapeutic Substances Act.

YOU CAN HAVE ABSOLUTE CONFIDENCE IN

LHC

Sizes 2|0, 0 and 1 are recommended for general surgery, because finer gauges mean less scar tissue and quicker healing.

WHG/L3

IN PICTURES — STEP BY STEP

Announcing a New and Important Publication in Eight Volumes

OPERATIVE SURGERY

Under the General Editorship of

CHARLES ROB, M.C., M.CHIR., F.R.C.S.

Professor of Surgery, St. Mary's Hospital, London

and

RODNEY SMITH, M.S., F.R.C.S.

Surgeon, St. George's Hospital, London

Associate Editors for Special Subjects:

J. CRAWFORD ADAMS, M.D., F.R.C.S.; R. J. V. BATTLE, M.B.E., M.CHIR., F.R.C.S.; SIR STEWART DUKE-ELDER, K.C.V.O., PH.D., D.SC., LL.D., M.D., F.R.C.S.; MAXWELL ELLIS, M.D., M.S., F.R.C.S.; C. M. GWILLIM, M.D., F.R.C.S., F.R.C.O.G.; WYLIE MCKISSOCK, O.B.E., M.S., F.R.C.S.; ROBERT GUY PULVERTAFT, M.B., B.CHIR., F.R.C.S.

THIS work represents an entirely new approach in publishing to the Subject of Operative Surgery.

The first volume will be available in the near future and full particulars will be announced very shortly.

BUTTERWORTHS

88 KINGSWAY · LONDON, W.C.2

Showroom: 11-12 Bell Yard, Temple Bar, W.C.2

A

SURGICAL DIAGNOSIS

Philip Thorek, M.D., F.A.C.S., F.I.C.S.

Professor of Surgery, Cook County Graduate School of Medicine; Co-Surgeon in Chief of the American Hospital; etc.

A new book by Professor Thorek is of wide interest. His new *Surgical Diagnosis* is primarily for students—it is clear, comprehensive, dogmatic, and well illustrated—but it will also be of value as a general reference work. It is well up-to-date. Coming from the author's long experience of surgery, writing and teaching, it is a notable book.

7 × 10 **320 Pages** **Very Fully Illustrated** **96s. net**

SURGERY OF THE AMBULATORY PATIENT

L. Kraeer Ferguson, M.D., F.A.C.S.

"... will be of great use to house surgeons and casualty officers ... the format ... and the illustrations are alike excellent."—*The Practitioner.*

"... one of the great features ... is the wealth of good illustrations ... The whole volume is an encyclopaedia of minor surgical conditions. The popularity of this work will certainly continue ..."—*The Medical Press.*

3rd Edition **6 × 9** **866 Pages** **Fully Illustrated** **96s. net**

PITMAN MEDICAL PUBLISHING CO. LTD.
45 NEW OXFORD STREET . LONDON . W.C.I

H. K. Lewis & Co. Ltd.

Medical Publishers and Booksellers

136 GOWER STREET LONDON, W.C.I
(Adjoining University College and Hospital)

Telephone: EUSton 4282 (7 lines).
Telegrams: Publicavit, Westcent, London.
Established 1844

Medical Lending Library

Annual Subscription from Twenty-five Shillings
Prospectus post free on application

Bi-monthly List of New Books and New Editions added to the Library sent post free on request

THE LIBRARY CATALOGUE revised to December, 1949, containing a Classified Index of Authors and Subjects.

Subscribers **17s. 6d.** net. Non-subscribers **35s.** net. Postage **1s. 9d.**

Supplement 1950 to 1952.
Subscribers **3s.** net. Non-subscribers **6s.** net. Postage **10d.**

NEW BOOKS ADDED IMMEDIATELY UPON PUBLICATION

THE WORLD'S GREATEST BOOKSHOP

FOYLES
*** FOR BOOKS ***

FAMED CENTRE FOR MEDICAL BOOKS

All new Books available on day of publication. Secondhand and rare Books on every subject. Stock of over three million volumes.

Depts. for Gramophone Records, Stationery, Music, Handicraft Tools and Materials, Magazine Subscriptions, Lending Library, Foreign Stamps.

119-125 CHARING CROSS ROAD LONDON WC2.

Gerrard 5660 (20 *lines*) ★ *Open* 9–6 (*incl. Sats.*)

NEAREST STATION: TOTTENHAM COURT ROAD

Just Published

PERIPHERAL VASCULAR DISORDERS

Edited by PETER MARTIN, V.R.D., M.Chir., F.R.C.S. (Ed.), R. B. LYNN, F.R.C.S., J. HENRY DIBLE, M.B., F.R.C.P., and IAN AIRD, Ch.M., F.R.C.S. (Edin. and Eng.)

856 *Pages* 568 *Illustrations* **£5 10s.**

TWO NEW BIOGRAPHIES OF SURGEONS

SIR WILLIAM ARBUTHNOT LANE.
An Enquiry into the Mind and Influence of a Surgeon.
By T. B. LAYTON, D.S.O., M.S., F.R.C.S.
136 *Pages* 9 *Plates* **21s.**

SIR JOHN BLAND SUTTON, 1855-1936.
By W. R. BETT, M.R.C.S. Foreword by Lord Webb-Johnson.
108 *Pages* 6 *Plates* **20s.**

TWO RECENT SUCCESSFUL BOOKS

BODY FLUIDS IN SURGERY.
By A. W. WILKINSON, Ch.M., F.R.C.S.E.
222 *Pages* 7 *Illustrations* **16s.**

OUTLINE OF ORTHOPAEDICS.
By J. CRAWFORD ADAMS, M.D., F.R.C.S.
432 *Pages* 347 *Illustrations* **32s. 6d.**

THE PATHOLOGY AND SURGERY OF THE VEINS OF THE LOWER LIMB

By HAROLD DODD, Ch.M., F.R.C.S., and F. B. COCKETT, B.Sc., M.S., F.R.C.S.

470 *Pages* 511 *Illustrations* **65s.**

If you do not subscribe to *THE JOURNAL OF BONE AND JOINT SURGERY* you should at least buy a copy of the February issue, which is the Sir Thomas Fairbank Birthday Volume. This special issue is obtainable in paper covers at **£2** or cloth bound **£2 5s.** It has been widely acclaimed as a superb production.

E. & S. LIVINGSTONE LTD., Medical Publishers, EDINBURGH

BAILLIÈRE BOOKS FOR THE SURGEON

Lewison's Breast Cancer *by* EDWARD F. LEWISON, M.D., F.A.C.S., Assistant Professor of Surgery, The Johns Hopkins University School, with seven expert contributors. A most valuable and comprehensive summary of the vast store of information now available on breast cancer. Including a chapter on Surgical Anatomy of the Breast by RICHARD S. HANLEY, F.R.C.S. 482 pages with 188 figs. and 4 colour plates. "Undoubtedly the best book on cancer of the breast in the English language . . . a mine of accurate information . . . beautifully produced and illustrated."—*British Medical Journal. Price* 114s., *postage* 2s. *extra.* ★

Peer's Transplantation of Tissues. Vol. 1: Cartilage, Bone, Fascia, Tendon and Muscle *by* LYNDON A. PEER, M.D. A wholly comprehensive work which correlates and evaluates a vast amount of material hitherto scattered throughout the literature. "There can be little doubt that it will be the reference volume on the subject for many years to come . . . An excellent production with first-class illustrations."—*British Journal of Surgery.* 407 pages with 163 figs. *Price* 108s., *postage* 2s. *extra.* ★

Belcher and Grant's Thoracic Surgical Management and **Pender and Robinson's Diagnosis and Management of Urological Cases** (*each* 21s., *postage* 1s. 2d. *extra*) provide for the post-graduate and resident wholly reliable and practical handbooks. ★

7-8 Henrietta Street, London, W.C.2

ACUTE INTESTINAL OBSTRUCTION

By RODNEY SMITH, M.S., F.R.C.S.

With a chapter on Radiological Diagnosis by ERIC SAMUEL, M.D., F.R.C.S., F.F.R.

"Every known cause of obstruction, from the level of the pylorus to the anus, is covered, and the book is a reference work which can be well recommended to all surgeons."—*The Lancet.*

268 *pages* 101 *illustrations* **18s.** *net*

A PRACTICE OF THORACIC SURGERY

A. L. D'ABREU, O.B.E., Ch.M., F.R.C.S.

"Well written, profusely illustrated and beautifully produced. It covers the whole field and is well balanced . . . eminently readable."—*South African Medical Journal.*

599 *pages* 343 *illustrations* **80s.** *net*

EDWARD ARNOLD

41 MADDOX STREET, LONDON, W.1.

SURGERY OF THE SYMPATHETIC

By A. Lee McGregor

10×7 in. 200 pages. 101 illustrations

30s., post **1s. 3d.**

This new book, written by the well-known author of *A Synopsis of Surgical Anatomy*, does not pretend to be comprehensive, but is a guide embracing the essentials necessary to the understanding of the sympathetic system. The field is one which concerns not merely the specialist, but also the student, the practitioner, and the general surgeon.

"The smooth and flowing style is very agreeable to read . . . . the book will make a particular appeal to surgeons interested in the details of the operative surgery of the sympathetic nervous system."—*The Practitioner.*

JOHN WRIGHT & SONS LTD., BRISTOL

Christopher's SURGERY

New (6th) Edition *Just Published*

By 87 American Authorities. Edited by LOYAL DAVIS, Chairman of Department of Surgery, Northwestern University Medical School. 1484 *pages, with* 1359 *illustrations.* **108s. 6d.**

A complete picture of every common surgical disease, including incidence, etiology, pathology, diagnosis, principles of treatment, technique of the recommended form of treatment, complications and prognosis. As a reference source of surgical diseases and as a reflection of current surgical practice in America, this new edition of Davis-Christopher has no peer.

New! SURGERY OF THE ALIMENTARY TRACT

By RICHARD T. SHACKLEFORD, Assistant Professor of Surgery, Johns Hopkins University School of Medicine. *In three volumes, totalling* 2842 *pages.* 2800 *illustrations. Price of the complete work* **£21.**

A new encyclopedic work, based on the world-famous Bickham's Operative Surgery.

It covers exhaustively nearly 600 procedures for over 150 disorders of the alimentary tract, liver, gallbladder, pancreas and spleen—including hernia.

Here is what every surgeon and gastro-enterologist will want to know about surgery of the alimentary tract.

Vol. 1: The Esophagus; The Stomach and Duodenum; The Liver; The Gallbladder and Extrahepatic Biliary Ducts.

Vol. 2: The Pancreas; The Spleen; The Small Intestine (Jejunal and Ileal Portions); The Peritoneum, Omenta and Mesentery; The Colon.

Vol. 3: The Anorectal Tract; Excisions of the Rectum; Hernia of Gastrointestinal Tract; Incisions.

W. B. SAUNDERS COMPANY LIMITED

7 GRAPE STREET . LONDON, W.C.2.

Mr. Peter Lawrie and Mr. S. Krol will shortly begin work on research into the absorption properties of suture material and other related matters. This work will be carried out in the new research unit at the Buckston Browne Research Farm at Downe by arrangement with the Royal College of Surgeons of England. Investigations in this field are expected to yield much information of value in the development of modern surgical techniques and papers will be published from time to time.

Ethicon Suture Laboratories Ltd.,
Edinburgh.

HENRY KIMPTON'S PUBLICATIONS

New (3rd) Edition — Just Ready

CAMPBELL'S OPERATIVE ORTHOPAEDICS

Edited by **J. S. SPEED,** M.D. *and* **R. A. KNIGHT,** M.D.

Third Edition, Revised and Enlarged. In Two Volumes

10 × 7 in. | 2192 Pages | 1323 Illustrations and 2 Coloured Plates | Cloth | Price **£14 10s.** net

New (3rd) Edition — Just Ready

A MANUAL OF FRACTURES AND DISLOCATIONS

By **BARBARA B. STIMSON,** A.B., M.D., Med.Sc.D.

Third Edition, Revised

8 × 5 in. | 224 Pages | 97 Illustrations | Cloth | Price **34s.** net

New (2nd) Edition — Just Ready

CHEST X-RAY DIAGNOSIS

By **MAX RITVO,** M.D.

Second Edition, Revised and Enlarged

10 × 7 in. | 640 Pages | 633 Illustrations and a Coloured Plate | Cloth | Price **£6** net

New Book — Just Ready

THE SPINE

By **BERNARD S. EPSTEIN,** M.D.

10 × 7 in. | 539 Pages | 721 Illustrations on 331 Figures | Cloth | Price **£6** net

New Book — Now Ready

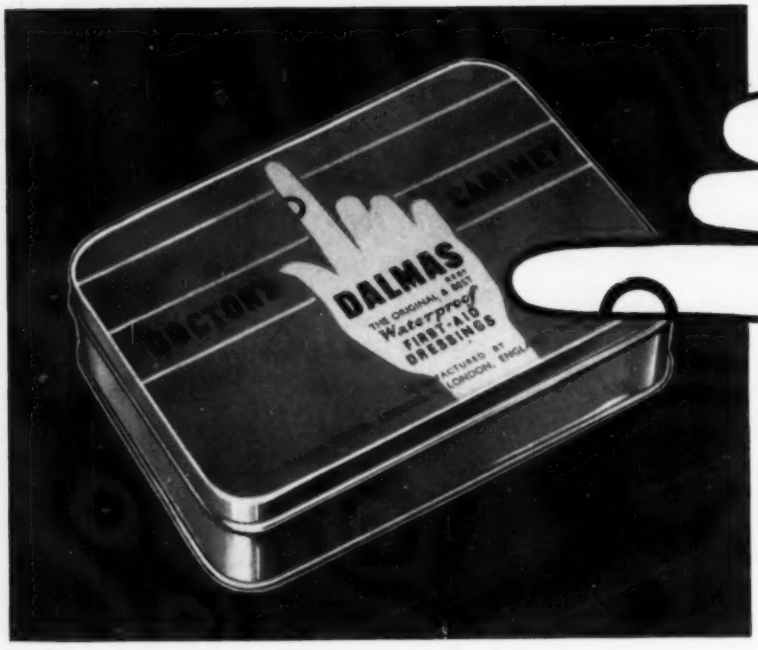
BABCOCK'S PRINCIPLES AND PRACTICE OF SURGERY

Edited by **KARL C. JONAS,** B.S., M.D., F.A.C.S.

10 × 7 in. | 1543 Pages | 1006 Illustrations and 10 Coloured Plates | Cloth | Price **£6 15s.** net

25 Bloomsbury Way **HENRY KIMPTON** **London, W.C.1**

Medical Book Department of Hirschfeld Brothers Ltd.



180 WATERPROOF dressings in the DALMAS Doctor's Cabinet

DALMAS waterproof dressings provide safe and speedy first-aid for all wounds, cuts and common casualties. Self-adhesive, they are simple to apply and flex with every movement like a second skin. The special Doctor's Cabinet contains 180 dressings in seven sizes and shapes together with a spool of Dalmas Strapping. Fully descriptive literature will be sent on request.

Cabinets 16/8 each. Complete Refills 14/10 each.

DALMAS LIMITED, LEICESTER & LONDON Established 1823

M5/A

To save his skin...

Achilles was dipped in the Styx

THE new skin protective for medical use is 'SIOPEL' Cream. It is proving to be a valuable aid against dermatoses caused by water-soluble irritants.

'SIOPEL' Cream has a wide field of application in medical practice, in reducing the incidence of chronic dermatoses, and in preventing the skin from becoming macerated by moisture and discharge. It is especially indicated :

1 In the management of occupational dermatoses caused by water-soluble irritants.

2 In post-operative care of the skin following colostomy, ileostomy, hæmorrhoidectomy and the like.

3 In dealing with the effects of incontinence.

'SIOPEL' cream

Incorporating a specially selected silicone

Issued in tubes of 50 grammes and containers of 500 grammes

IMPERIAL CHEMICAL (PHARMACEUTICALS) LIMITED, WILMSLOW, CHESHIRE

A subsidiary company of Imperial Chemical Industries Limited

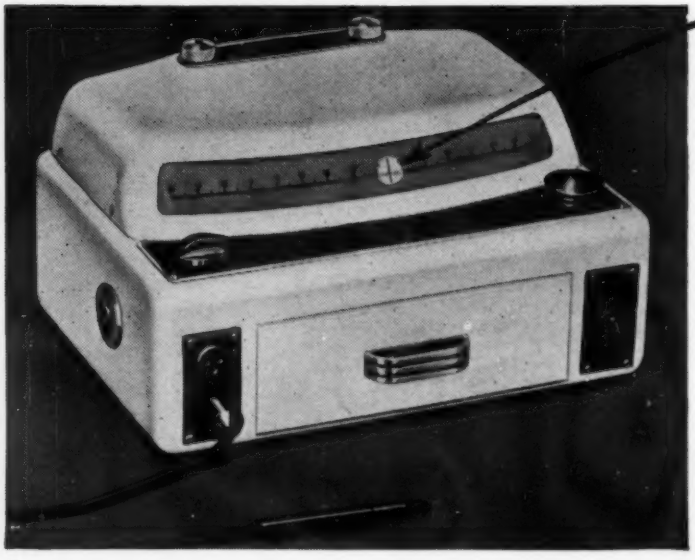
ICI

Ph. 616

Banish tedious temperature measuremen

IN WARDS AND OPERATING THEATRES WITH THE

TE3 ELECTROTHERMOMETER



INSTANT ACCURATE TEMPERATURE READINGS

- Surface, cavity, and internal body temperatures easily measured with sterilisable applicators.
- Accuracy : ±0.1°F.
- Up to 15 patients may be connected to one instrument under selective control from a central station.

Write for full details to :—

SIEREX LIMITED

241 Tottenham Court Road, London W1

Telephone LANgham 2464

"SANOID" STERILISED SURGICAL CATGUT

Prepared under M.o.H. Licence No. 40

Over forty years' experience is behind the manufacture of " Sanoid " Sterilised Surgical Catgut. Our capacity has recently been considerably increased to enable us to fulfil increased demand.

TENSILE STRENGTH : " Sanoid " Surgical Catgut easily surpasses official requirements for minimum average strength.

GAUGING : Every strand of " Sanoid " Surgical Catgut has been checked at four points by dial micrometer.

FLEXIBILITY : Heat treatment necessarily tends to make Catgut to some degree wiry and brittle due to loss of moisture, but the composition of the solution in which " Sanoid " Surgical Catgut is tubed is such that the maximum possible strength and flexibility are restored to the gut and retained by it under long storage periods.

SMOOTHNESS : " Sanoid " Surgical Catgut is of great smoothness but at the same time holds securely on the knot.

STERILITY : " Sanoid " Surgical Catgut conforms to the stringent bacteriological tests for sterility as laid down by the Ministry of Health in the Therapeutic Substances Regulations.

We invite your inquiries for Catgut and other Surgical Ligatures. Samples will be provided with pleasure.

A PRODUCT OF *Cuxson Gerrard & Co. Ltd.* Oldbury, BIRMINGHAM

DRY STERILISATION
WITH THE S223F OVEN

THIS is the Oven used for the experiments on accurate sterilisation at 160° C.

It was found that the fan circulation was essential to give reasonably even heating with a big load, and the special fan-cooling device and massive heaters give real reliability under continuous use at this temperature.

IF YOU DRY STERILISE ALL SURGEONS' CUTTING INSTRUMENTS IN THE THEATRE, YOU SOLVE THE SHARPENING PROBLEM

Available in grey or white to order

TOWNSON & MERCER LIMITED

CROYDON *Telephone:* THOrnton Heath 6262 **ENGLAND**

I watched the wound heal through a Dalmas Transparent Dressing

THE DALMAS TRANSPARENT WOUND DRESSING is composed of a basic strong transparent film, made self-adhesive at its longitudinal margins. The mode of preparation renders it antiseptic for a long period after manufacture. The absorbent margins each side of the window have been treated so as to render them bacteriostatic.

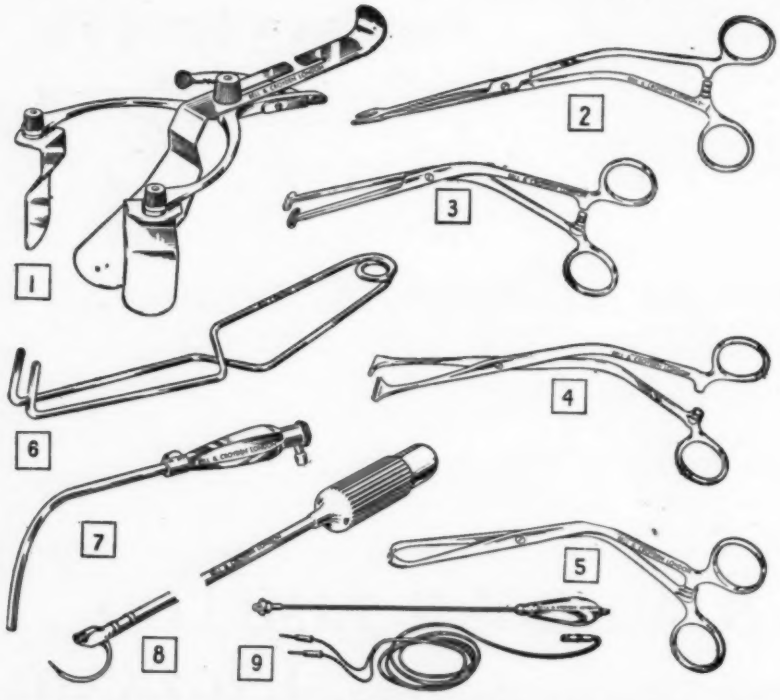
The Dalmas Transparent Wound Dressing is ready for direct application over a sutured wound after merely removing the protective face muslin.

Two widths 3″ and 4½″, three engths 8″, 12″ and 36″.

DALMAS

DALMAS LIMITED, LEICESTER & LONDON. Established 1823

Instruments for Retropubic Prostatectomy



as used by
Mr. Terence Millin, F.R.C.S.

1. Millin's Retractor. Self retaining with adjustable blades.
2. Millin's Ligature Carrying Forceps.
3. Millin's Capsule Forceps.
4. Millin's Vulsellum Forceps.
5. Millin's Tissue Forceps.
6. Millin's Bladder Neck Spreader.
7. Millin's Sucker. The curved nozzle allows the field to be kept dry without obstructing.
8. Harris' Boomerang Needle Holder. Supplied complete with three needles.
9. Millin's Malleable Lamp.

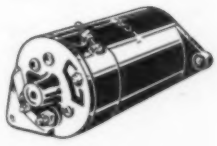
Enquiries welcomed for these and all other types of Surgical Instruments.

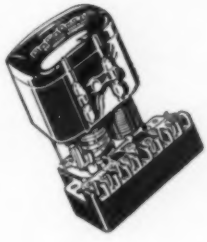
JOHN BELL & CROYDEN *MAKERS OF SURGICAL INSTRUMENTS & APPLIANCES*
WIGMORE STREET, LONDON, W.1 'Phone: WELbeck 5555

NO WAITING

FOR ELECTRICAL REPAIRS

For most cars after 1936 you can obtain a factory reconditioned replacement Magneto, Distributor, Starter, Dynamo or other electrical unit immediately. It prevents that idle waiting period while a repair is undertaken. It will pay you in time and cost if your unit requires a major repair. Full details of this scheme from your local garage or Lucas Agent.





LUCAS

B90 *immediate* **EXCHANGE SERVICE**

JOSEPH LUCAS LTD · BIRMINGHAM 19

in prostatic carcinoma

A NEW FAT-STORED ŒSTROGEN

TACE

TACE

offers a new treatment for prostatic carcinoma and other conditions responsive to oestrogen therapy. While resembling stilboestrol and hexoestrol chemically, it differs clinically in these important respects;

TACE has virtually no effect on the pituitary. Resistance does not develop on prolonged therapy and in cases where resistance to other œstrogens has already developed, 'TACE' will often offer the prospect of continued relief of symptoms.

TACE is virtually free from the usual side effects of œstrogen therapy. Painful gynæcomastia does not occur in the male—nausea, vomiting and withdrawal bleeding are not produced in the female.

TACE is stored in body fat—its activity is gradually released in a manner closely resembling natural œstrogen secretion.

REFERENCES

Endocrine Therapy in Carcinoma of the Prostate. Carrol, Grayson, and Brennan, R. V.: *J. Amer. med. Ass.* (1955), **157**, 581.

Follow-up Study of Tace-treated Prostatic Cancer Patients. Smith, P. G., Rush, T. W., and Evans, A. T.: Read at the TACE Symposium, Cincinnati, January 17th, 1952.

INDICATIONS

1. **PROSTATIC CARCINOMA**
2. **MENOPAUSAL SYNDROME**
3. **INHIBITION OF LACTATION**

'TACE' is available in capsules each containing 12 mg. chlorotrianisene in bottles of 60 and 300 capsules. *Detailed literature is available on request.*

Merrell

'TACE' brand chlorotrianisene is distributed in the United Kingdom and Eire by

RIKER LABORATORIES LTD., LOUGHBOROUGH, LEICS.

for the Wm. S. Merrell Co., London.

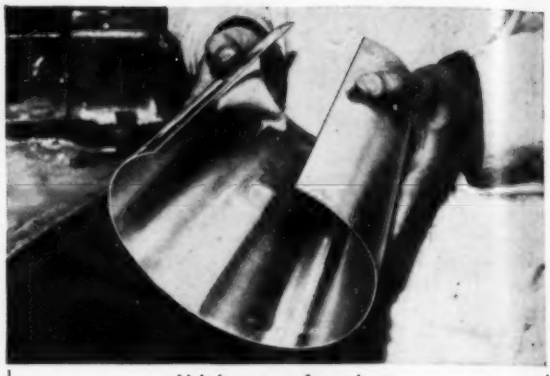
Individual Development Throughout All Stages

Artificial legs made by the VESSA organisation are the product of skilled craftsmen whose sole object is to meet the individual amputee's requirements.

We feel that a contributing factor to the success of our legs is the infinite care and attention given to the making of the socket; no standard "jigs" or "formers" are used in its development and, as the illustrations show, the socket is anatomically shaped to suit individual requirements, thereby ensuring the utmost comfort.

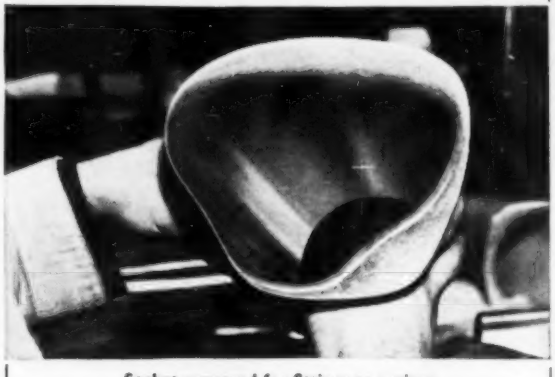
Furthermore the VESSA leg is backed by a comprehensive refit and repair service throughout the country.

We should be happy to give you details of our range of artificial legs and orthopaedic appliances as well as particulars of your nearest Fitting Centre or Agent.



Alclad cone cut from sheet.

Preparing to shape anatomical features of socket.



Socket prepared for fittings to patient.

Socket after successful fittings, rimmed, and ready for assembly to leg.

VESSA
VOKES ERNST SCIENTIFIC SURGICAL APPLIANCES LTD.
(A Subsidiary Company of Vokes Ltd.)

HENLEY PARK, GUILDFORD Telephone: Guildford 62861

VE/2

THE PROPHYLAXIS OF SHOCK

A MAJOR OPERATION is in progress. It is essential that the patient's circulating blood volume be maintained—especially during the following critical twenty-four hours.

A CLEAR CASE FOR DEXTRAVEN, the established clinical dextran solution. Dextraven is eminently suitable for the prophylaxis of surgical shock. Also for immediate treatment following trauma. Raising the blood pressure swiftly and surely, it stays in the circulation in significant concentration during the vital post-operative twenty-four hours.

DEXTRAVEN CAN BE given immediately by intravenous infusion. Stable indefinitely under all conditions, it requires no special storage precautions.

DEXTRAVEN IS APPROVED by the Ministry of Health. Fully descriptive literature is available and a Technical Information Service is always at your disposal.

A clear case for DEXTRAVEN

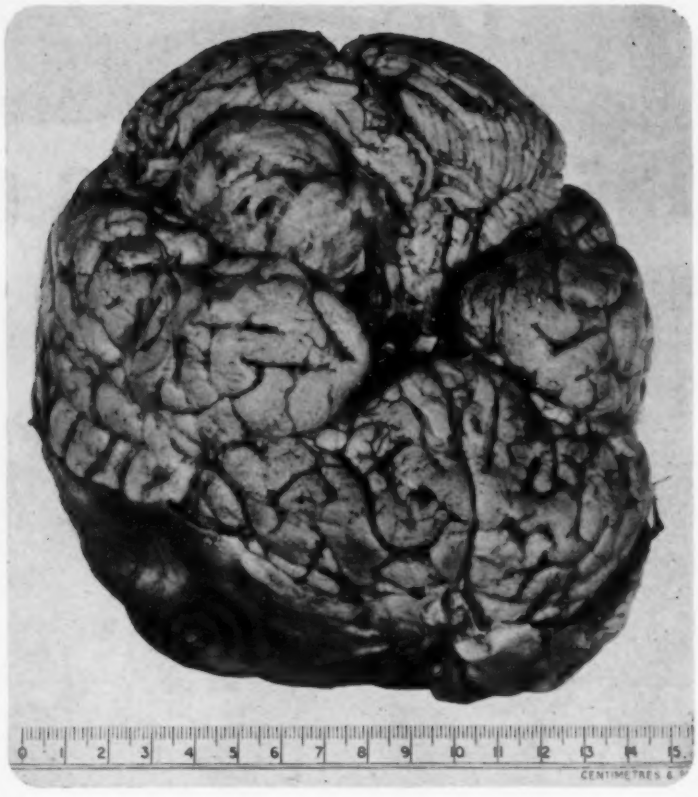
TRADE MARK

BENGER LABORATORIES LIMITED · HOLMES CHAPEL CHESHIRE

A BENGER PRODUCT

D.5 (REV. 2)

Ideal for teaching and demonstration purposes



To fill files quickly with material in the most useful form for presentation and discussion, make it a practice to photograph the significant aspects of all noteworthy cases . . . on 'Kodak' Film —black-and-white and colour.

Then to present such material with maximum effectiveness, use a 'Kodaslide' Projector.

This robust, easily-operated portable projector throws brilliant screen pictures from 2 × 2 inch slides (or, with accessory holder, from 35 mm. film strips). It produces images with superb edge-to-edge brilliance and colour accuracy.

For details of lenses, lamps, etc., write for booklet.

'KODASLIDE' Projector MODEL 5 made by Kodak

Kodak Limited, Medical Sales Division, Kodak House, Kingsway, London, W.C.2.

'Kodak' and 'Kodaslide' are registered trade-marks

——It enables the patient to be turned easily and with little effort from the supine to the prone position; or vice versa.

THE Emesay TURNING FRAME

THIS IS AN IDEAL APPARATUS for nursing which overcomes the many difficult problems presented in cases suffering from burns and paralysis; in the post operative treatment of spinal and pelvic fracture and spinal fusion, and in any instance where it is necessary to maintain the patient immobile with an absolute minimum of handling.

A strongly constructed steel framework with its special canvas beds gives firm support together with comfort to the patient, whilst facilities for bed-pan service, urination, and drainage are provided.

The sliding platform below can be used as a table top for feeding or reading by the patient when lying prone.

An illustrated informative folder is available, on request, from the manufacturers.

THE MEDICAL SUPPLY ASSOCIATION LTD.

PARK ROYAL ROAD, N.W.10 & 95, WIMPOLE STREET, W.1
LONDON

PHONES: ELGar 4011 (Ten lines)

EDINBURGH: 10–13, TEVIOT PLACE

SHEFFIELD: 6–12, HOLLY STREET

Powerful Pliers with side cutters.

Eldon Tucker's Hallux Forceps.

Gavin Miller's clamps for rectal incision.

NEW INSTRUMENTS

5319

DOWN BROS. and MAYER & PHELPS LTD.

Surgical Instrument Makers

Head Office: 92–94 BOROUGH HIGH STREET, LONDON, S.E.1 *Tel.:* HOP. 4141
Showrooms: 32–34 NEW CAVENDISH STREET, LONDON, W.1 *Tel.:* WEL. 3764
and at 70 Grenville Street, TORONTO